THE UNIVERSITY OF HULL

Investigating Sustainable and Resilient Supply Chain Management in Thai Manufacturing

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ABSTRACT

This thesis investigates the combinatory relationship between sustainable supply chain management (SSCM) and supply chain resilience management (SRES) by developing a new concept of sustainable and resilient supply chain management (SResSCM). Supply chain management has been implemented by organizations for more than three decades and has been developed by integrating different but independent concepts, such as SSCM. Furthermore, organizations also pay attention to business continuity during periods of risk and disruption. Most organizations prepare alternative plans to maintain resilience and SRES was developed to fulfil this strategy. Both SSCM and SRES concepts are important for organizations in order to improve supply chain performance, and are linked in many ways. However, our knowledge is lacking on the combinatory relationship and effects of these two elements as little empirical research has previously been done. This thesis undertakes such empirical research by applying a three-phase, mixed-methods approach: semi-structured interviews to inductively confirm the combination of these two independent concepts, a survey of Thai manufacturers in the electronic/electrical and automotive sectors, and post-survey structured interviews to validate the survey findings. Thailand was chosen as the context for the study as it is a major manufacturing nation for western customers.

The research found interconnections between SSCM and SRES from the practitioners' perspectives which enabled the theoretical development of a 'House of SResSCM' framework that organizations around the world can apply. This thesis also contributes theoretically by providing measurement scales of SResSCM practices to assess and define current levels of adoption SSCM and SRES, which supply chain managers can implement in their organization to improve current practices. Finally, the Thai Government could use this study to support Thai manufacturing and provide direction for supply chains to become more sustainable and resilient.

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Chapter 1 INTRODUCTION

1.1 Research background

Supply chains (SCs) encompass both products and services in relation to suppliers, manufacturers and customers, and provide information and material that firms can use to effectively meet their missions and goals (Stevens, 1989). Supply chain management (SCM) is considered a strategic weapon to enhance effectiveness and heighten a firm's performance, such as improved customer service, enhanced profitability and increased competitiveness (Gunasekaran et al., 2001). In recent years researchers have found it is essential to apply practices which focus on improving individual sustainability dimensions such as environmental, economic, or social, rather than entire supply chains (Beske, 2012). During the last decade, many organizations have developed processes to combine decision-making in the short and long-term within the sustainability pillar (Ahi and Searcy, 2015). Moreover, both supply chain risk management and supply chain resilience management offer interesting pointers, from a theoretical and practical perspective, to improve sustainability in organizations (Ponomarov and Holcomb, 2009).

In a volatile, high demand market, sustainability and resilience in an SCM context can lead organizations to generate more competitive advantage (Govindan et al., 2014). Fiksel (2006) argued that integration between sustainable and resilient concepts in SCs will increase business opportunities related to green technology, reduction of raw materials and energy used, and the development of innovative pathways for the recovery and re-use of waste streams from places of virgin resources. The incorporation of sustainability and resilience across supply chains is a greater, more challenging issue than consolidating these concepts under a single organization (Ahi and Searcy, 2015). Therefore, the objective of this thesis is to integrate sustainability and resilience into SCM as a concept named sustainable and resilient supply chain management (SResSCM) which includes a related framework, and to implement this integration at a supply chain level rather than focus in a

single organization. Even though sustainability and resilience are two distinct constructs in the SCM field, in studying their relationship, Fiksel (2003) found them to be interlinked. Thus, if organizations understand this relationship, they might gain more benefits through becoming more sustainable and resilient, as the concepts of SSCM and SRES will support each other once successfully implemented.

The concept of supply chain management (SCM) has been widespread in both academic and practitioners since 1980s, for example Li et al. (2006) mentioned that "effective supply chain management has became a potentially valuable way of securing competitive advantage and improving organizational performance since competition is no longer between organizations, but among supply chains" (p.107).

Sustainable supply chain management (SSCM) is a concept that operates well according to traditional measures, i.e. profit and loss from environmental and social perspectives (Pagell and Wu, 2009). Seuring and Müller (2008b) defined SSCM as: "*the management of material and information flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e. economic, environmental and social into account which are derived from customer and stakeholder requirements*" (p.1700). Organizations have applied the SSCM concept and practices to satisfy multiple and conflicting objectives, such as increasing profits while decreasing operating costs, reducing environmental impact and improving social well-being. Globalization, in the form of governments, consumers, non-governmental organizations (NGOs) and environmentalists, is focusing on the enhanced pressure on the earth's natural resources, favouring businesses with higher environmental expectations, incorporating eco-friendly products, social and economic performance, namely the triple bottom line (TBL) (Carter and Rogers, 2008).

On the other hand, Carvalho et al. (2011) defined supply chain resilience management (SRES) as: "*the ability of a supply chain to return to its original state or to a new, more desirable state, after experiencing disturbance or avoiding the occurrence of failure*" (p.154). The aim of resilience is to protect the shift to an

undesirable position. In addition, SRES has gained momentum as a competitive advantage within SCs due to the increase in unforeseen disruptions (Carvalho et al., 2012b). As described by Sawik (2013), unpredictable incidents emerge from man-made, as strikes, terrorism and economic crisis, or natural disasters, as fires, floods, earthquakes and equipment breakdown. To reduce these risks, SCs or organizations should incorporate event readiness, or provide efficient and effective activity, to be able to recover their original state or even better, once the disruption has passed (Ponomarov and Holcomb, 2009). Traditional supply chain resilience focused on the ability of SCs to recover their performance to a desired level after a disruption occurs, but did not consider the environmental impact and contingency strategies (Christopher and Peck, 2004a).

Once SSCM and SRES are combined together, it is interesting to examine performance for SCs and organizations related to the SResSCM concept. Thus, this thesis will study and discuss the impact of sustainable and resilient supply chain management from the practitioner's perspective and then return the findings to the academic field.

Consequently, there is an increasing importance of SC risk and resilience and SC sustainability both in academic and practice. However, links between both where one may affect the other are lacking as there is little research investigating an integrated approach of risk/resilience and sustainability. The researcher is also interested in filling this research gap. Accordingly, this thesis presents an integrated conceptual model that is empirically tested with an objective of providing better explanation of the integrated phenomenon. Therefore, it is interesting to see to what extent SSCM and SRES overlap, which concepts can be reinforced or provide more conflicts between them, and identify a list of sustainable and resilient supply chain management (SResSCM) practices that promotes both concepts. The researcher intends that academics can apply findings from this thesis for SSCM and SRES research through, for instance, the definition and house of SResSCM, which are developed in this thesis; while practitioners can take the findings and apply the features from this thesis for their organizations or SCs. For example, measurement

scales of SResSCM developed in this thesis that can assess current implementation practices in organizations for policy makers/top management to provide possible improvement.

1.2 Research context

Accordingly, the aim of this thesis study is to empirically create a new framework of SResSCM and assess performance relating to SResSCM practices. The study proposes to fill the gap by developing a framework and conceptual model to investigate the impact of SResSCM practices on supply chain performance and organizational performance.

To achieve this aim the researcher is focusing on the specific context of Thailand. In 2011 Thailand suffered huge flooding, which had a huge impact on Thai manufacturing. Some organizations permanently closed after the period of disruption, or else needed a long time to recover their manufacturing processes while other organizations were able to recover their production lines faster than their competitors. SRES strategy could hence support organizations in Thailand to maintain their businesses over a long period of time, making it an attractive place for foreign investors to invest. Furthermore, the researcher also believes that sustainability, which is quite a new concept in Thailand, could improve organizational production processes, making them more sustainable, and helping it to become the number one place of interest to do business in the world. Therefore, the researcher advocates that if Thai manufacturing can apply concepts of sustainability and resilience in its organizations, it will enhance supply chain performance in Thailand, which in turn is related to the Thai government's Manufacturing Logistics Development Plan.

This thesis should thus support organizations and SCs to reduce business waste, improve customer value, retain their sustainable operations, decrease environmental impact and overcome disruptions at the same time. The proposed model will be tested in Thailand, in the electrical, electronic and automotive

industry sectors, which are the main machinery industries in Thailand and offer a rich context to examine this issue. There are two main primary reasons Thailand was selected: 1) Thailand has some experience in about sustainable and resilient concepts before, for example they faced a huge flooding, or they had provided some policies related to environment, social or economic that were received from other countries as Japan, America or Europe, so the organizations will provide information related to sustainable and resilient more clearly, and 2) Thailand is the researcher's mother country so the researcher would like to provide insightful information for Thai's government to improve supply chain performance in term of sustainable and resilience for the future.

In general, the electrical, electronic and automotive industry sectors need to decrease or eliminate waste and environmental impact, improve workers' welfare and organizational long-term profits, and comply with environmental standards in customer countries, e.g. the European Waste Electrical and Electronics Equipment (WEEE) Directive and ISO14001 guidelines. These supply chains are under pressure to become more sustainable and more resilient. Therefore, Thai's electrical, electronic and automotive industry sectors were selected for several reasons: 1) Thailand is the regional leader in Southeast Asia for electrical, electronics and automotive industry exports (BOI, 2013, 2015a), 2) in 2011 and 2014, the electrical and electronics sectors contributed almost 24% of Thailand's annual export revenues (BOI, 2013, 2015b), 3) the automotive industry is a key industry for Thailand accounting for approximately 12% of the country's gross domestic product (GDP) and has the highest production growth rate among Southeast Asian nations that produce motor vehicles (BOI, 2015a), and 4) Thailand has many foreign investors in electrical, electronic and automotive manufacturing and also export to various other markets, such as United States, European Union (EU), Japan and China (BOI, 2015a, b).

Furthermore, Thailand is a supplier nation to the world as an outsourcing partner to developed nations in the West. Moreover, Western counties have an impact on Thailand and other Eastern nations through pressure to adopt some regulations.

For example, the EU has regulations such as WEEE and Restriction of Hazardous Substances (RoHS) (in the electrical and electronics sector, so it is necessary for Thailand to adopt SResSCM in order to respond to environment concerns, create competitive advantage and prepare for overcome any unforeseen disruptions. This would increase organizational ability to respond to unforeseen events and enable a positive impact on the network to return to its original state (Christopher and Peck, 2004a).

Therefore, this thesis study will provide insights and information to organizations around the world via the measurement scale of SResSCM practices to promote or enhance organizations' performance to be sustainable and resilient at the same time. Thus, Thailand is a good context for study since, it needs to improve SSCM and SRES as a developing nation.

1.3 Research problem, objectives and questions

Regarding logistics and SCM research, it can be seen that SSCM and SRES have received a certain amount of attention from organizations. SSCM is one topic that has been applied by organizations, but they do not apply all of them concurrently. For example some organizations implement practices related to environmental dimensions of SSCM rather than other organizational dimensions such as quality. Moreover, it can be seen that many organizations in the world face disruptions that impact on their production or SCs. These disruptions do not only impact single organizations, but also have an impact on wider SCs.

Based on the literature, few contributions have investigated the integration of sustainability and resilience in SCs and explored the impact on SSCM/SRES and performance measurement. Likewise, there have been few discussions about the difficulty of integrating SSCM and SRES concepts in performance measurement. For example, it can be found that organizations tried their best to reduce waste through SSCM practices, such as Just-in-time (JIT), which reduces on-hand inventory, while to be resilient, organizations usually hold extra inventory to deal

with potential supply chain disruptions. In other words, sustainability practices and resilience practices often clash but it can be seen that there are interactions between sustainability and resilience.

Moreover, there is a necessity to examine SSCM and SRES to enhance supply chain performance as acknowledged in the literature. As Hassini et al. (2012) highlighted "there is a strong demand in industry for such indicators and that more complex indicators are required" (p.79). Further, Mandal (2014) highlighted that organizations are more concerned to secure and restore their supply chain operations, whilst also focusing on process efficiency, so should consider the performance implications when designing supply chain resilience. Therefore, there is an opportunity for developing a new framework which integrates the SSCM and SRES concepts and applies performance measurement in SCs to enhance performance of organizations and supply chains to be more sustainable and resilient in the future.

Consequently, the combination of SSCM and SRES within a single definition as sustainable and resilient supply chain management (SResSCM) will provide guidelines for practitioners or policy makers. This thesis provides a suitable SResSCM framework that organizations can use, and provide scope for employees to understand their responsibility in realizing organizational policy. Furthermore, this thesis will focus on SResSCM practices applied by organizations, and support the improvement of supply chain performance. Current methods to measure performance in both SSCM and SRES practice are still lacking in the literature, so this thesis will develop and provide suitable measurement of SResSCM practices which can be applied in organizations and supply chains.

The research background and problem above lead to the development of research objectives and questions for this thesis. The main objective of this thesis is to review and develop a new definition of SResSCM. Further, this thesis aims to study the impact of SResSCM in organizations in terms of supply chain performance and

organizational performance. The research objectives were developed during the period of this study as follows:

RO1. To study and test SResSCM concept

RO2. To test appropriate SResSCM measures for organizations and supply chains

The above objectives generated four research questions as follows which reflect these two objectives:

RQ1. What is the current level of understanding and implementation of SSCM and SRES in organizations?

RQ2. What could be a suitable framework of sustainable *and* resilient supply chain management (SResSCM)?

RQ3. What would a valid measurement scale of SResSCM practices for performance improvement?

RQ4. What is the impact of SResSCM practices on supply chain performance and organizational performance?

Based on the findings from these questions recommendations are suggested as to how organizations can employ SResSCM definitions to fit their policy, or apply SResSCM practices to their procedures in the effective management of SCs. These research questions will answer the research objectives, and provide more understanding about SResSCM in the literature. These research objectives and questions are arising from the literature review of this study, which led to answer some research gaps, are explained in more detail in Chapter 2.

1.4 Research methodology

This study applies theoretical and methodological triangulation to enhance and increase the number of data collected, in order to identify the research phenomena from different perspectives (Mangan et al., 2004). The study applies a three-phase

methodological framework for development of the constructs, items and measurement scales from developed by Churchill (1979), DeVellis (2012) and Oppenheim (2000), as further discussed in Chapter 3. A triangulation approach for this thesis comprises an inductive approach in Phases One (semi-structured interviews) and Three (structured interviews), and a deductive approach in Phase Two (survey study to test six hypotheses). Based on the three phases of this approach, the empirical study uses each section to answer the research objectives and research questions.

The existing literature was reviewed and analysed using a systematic literature review (SLR) approach, outlined in Chapter 2, to gain maximum information from these fields. The relevant literature was used and applied during Phase One (Chapter 4) to review current understanding from the practitioner's perspective. The findings were then developed for the survey in Phase Two (Chapter 5), and the overall results were verified and validated in Phase Three (Chapter 6).

1.5 Contributions of this thesis

This study makes several contributions to theory, practice and policy as follows:

- Firstly, the research will provide a current understanding of practices implementation and SSCM and SRES integration in Thai manufacturing.
- Secondly, the research will provide a definition of SResSCM and related practices, developed from the existing literature and a triangulation research approach (Phases One to Three) in Thai manufacturing that can be applied for all organizations around the world.
- Thirdly, the research will assist organizations in assessing their implementation of SResSCM practices by using the SResSCM measurement and guide them on the appropriate SResSCM practices to implement in order to become more sustainable and resilient.
- Fourthly, the research will highlight potential supply chain performance improvements when organizations implement SResSCM practices

successfully. The expected findings could encourage managers and policy makers to study and implement SResSCM practices in organizations.

- Fifthly, the research will provide results for short and long-term impact on organizational performance from the use of SResSCM practices. Managers could study this research to review the impact over short and long-term periods, which will be of benefit to their organizations.
- Lastly, this thesis will contribute by providing suggestions to the Thai Government for developing better performance in sustainable and resilient in supply chains through influential policy related to SResSCM in the future.

1.6 Thesis structure

According to Figure 1.1, this thesis is divided into eight chapters. The following topics provide a brief synopsis of each of the chapters contained in the study.

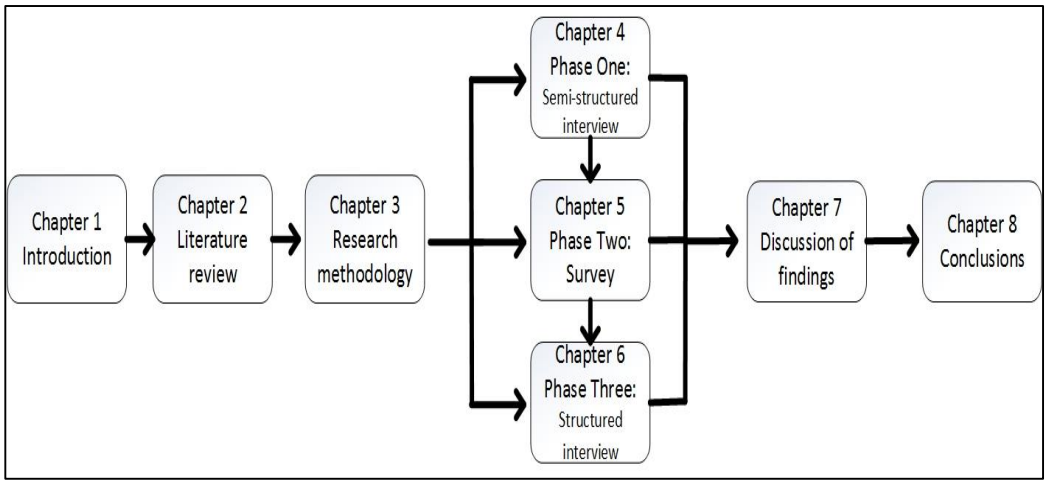

Figure 1.1: Thesis structure

- Chapter 1 – INTRODUCTION

This chapter provides an overview and introduction to the research, i.e. research background, research context, research problem, research objectives, research questions and research methodology.

- Chapter 2 – LITERATURE REVIEW

This chapter examines the existing literature by reviewing the literature on SSCM and SRES. A systematic literature review (SLR) is applied in this section. The concepts of SCM, SSCM, SRES, performance measurement and Thailand as the context are the themes. A conceptual model and six hypotheses are proposed for the Phase 2 empirical study.

- Chapter 3 – RESEARCH METHODOLOGY

Chapter 3 describes the methodology used in this study, including the research process, philosophical stance of the thesis, research design, a triangulation approach and ethical issues. The data collections within the three Phases are explained, Phase 1 comprising semi-structured interview; Phase 2 comprising a survey using structural equation modelling to test relationships; and Phase 3 comprising structured interviews to validate the research and findings.

- Chapter 4 – PHASE ONE: SEMI-STRUCTURED INTERVIEW

Analysis of the existing literature generates the initial concept of SResSCM and current performance measurement tools to be conducted in more detail in Phase One. Chapter 4 presents data gathered from semi-structured interviews with Thai managers. Data analysis presented this chapter assists the researcher to enhance understanding of SResSCM in an organization. The suggestions from the interviewees are integrated with the existing literature and tested in Phase 2.

- Chapter 5 – PHASE TWO: SURVEY

This chapter presents the survey process and results of self-administered questionnaires via an online survey and attached email. The number of usable returned questionnaires was 113. Non-biased responses, descriptive analysis, exploratory factor analysis (EFA) and PLS-SEM are shown in this chapter. The survey results from this phase are used to generate findings of this thesis, which are then validated in Phase 3.

- Chapter 6 – PHASE THREE: STRUCTURED INTERVIEW

Chapter 6 presents findings from the structured interviews to validate the findings from the previous two Phases of this study. The participants in this Phase are divided into two groups: 1) the first group from Phase One (representing five organizations), and 2) nine new participants interested in participating in this study. The results are presented in a way, which relates to all three Phases of the research.

- Chapter 7 – DISCUSSIONS OF FINDINGS

Chapter 7 consists of discussions of findings from the three previous Phases, obtained from quantitative and qualitative data collection and data analysis. According to the conceptual model and hypotheses set out in Chapter 2, this chapter links the findings to the relevant academic literature. The thesis research questions are addressed by discussions in this chapter, combining the findings from Phase One to Phase Three for each research question. In addition, sustainable and resilient supply chain management in Thailand is presented.

- Chapter 8 – CONCLUSIONS

The last chapter offers the conclusions of this thesis and summarizes the main theoretical and practical contributions. In addition, the assessment of managerial implications, research limitations and suggestions for future research are also provided at the end.

Chapter 2 LITERATURE REVIEW

2.1 Introduction

This chapter will present an overview of the literature in the field of SSCM and SRES and also the performance measurement field. A systematic literature review (SLR) approach was undertaken for this study, as recommended by Denyer and Tranfield (2009). SLR permits an evidence–informed approach for identifying, selecting and analysing secondary data (Colicchia and Strozzi, 2012). The review of the literature includes four key areas: (i) sustainable supply chain management (SSCM), (ii) supply chain resilience management (SRES), (iii) performance measurement (PM) and (iv) supply chain management in Thailand, all of which are critical for this study. Five SLR processes are shown in the following section. Next, key trends and issues from the SLR process are presented as the keynote to this chapter. After that, research gaps deriving from the SLR are explained. A new definition of sustainable and resilient supply chain management (SResSCM) is then presented and developed. Then, the development of research objectives and questions are discussed. Lastly, the conceptual model and hypothesis development for this thesis are presented in the last section.

2.2 A systematic literature review process

In the field of management, the relevant literature needs to be reviewed before conducting any empirical research in order to define the research questions (Tranfield et al., 2003). A systematic literature review (SLR) refers to a more narrative review, due to its methodological approach, implying a detailed description of the steps taken to select, scan and analyse the literature, aiming to reduce bias and increase transparency (Carter and Easton, 2011; Tranfield et al., 2003). Hence performing a structured literature review increases reliability and provides an appropriate means of synthesizing a rapidly growing field of knowledge (Miemczyk et al., 2012). For an SLR it is important to scope the idea to cover the research objectives (Seuring and Müller, 2008a), and the literature review is undertaken with a method which is systematic, explicit and reproducible (Fink, 2013). According to Mentzer and Kahn (1995), “the literature review is a major

contribution to research progress and it contributes a historical perspective of the respective research area and an in-depth account of independent research endeavours" (p.233). Moreover, Denyer and Tranfield (2009) define SLR as "a unique methodology that locates existing studies, selects and assesses contributions, analyses and synthesizes data and informs the results in such a way that permits reasonably clear summing up to be achieved about what is and is not known" (p.671). Furthermore, Meredith (1993) argue a "systematic literature review enables integrating a number of different works on the same topic, summarizing the common elements, contrasting the differences, and extending the work in some fashions" (p.8).

Denyer and Tranfield (2009) argue that a systematic review differs from other review methods because of its distinct and exacting principles. For instance, in SLR the researcher is required to set pre-specified relevance (step 1: question formulation and step 2: locating studies) and quality criteria for the selection/inclusion of studies (step 3: study select and evaluation) and to make such criteria transparent to readers (step 4: analysis and synthesis and step 5: reporting and using the results). Through the SLR process it was possible to select the most relevant papers that have contributed to theory-building in the field of SSCM and SRES. The SLR steps for this study are shown in detail in Figure 2.1below.

Figure 2.1: Overview of the five-steps systematic literature review process (*Source: Denyer and Tranfield (2009)*)

The reason the researcher used the SLR process is because SLR is systematic through a rigorous analysis of the literature and has become a standard process at this moment. For instance, the importance of this standard is demonstrated through a quick review of the table of contents for *International Journal of Physical*

Distribution & Logistics Management (IJPDLM), *Supply Chain Management: An International Journal* (SCMIJ) and *International Journal of Logistics Management* (IJLM) from 2015–2017 inclusive. IJPDLM published 125 articles of which 18 were SLR papers (about 15% of published papers during 3 years). The other two journals, as SCMIJ and IJLM, published about 12% (16 of 130) and 8% (11 of 136) of articles using SLR, respectively.

There were some advantages when applying SLR process in this thesis. For example, the SLR helped the researcher to review the existing literature more clearly, highlighted areas where research is needed, and the search criteria of published work is rigorous and comprehensive and results in the facilitation of theory development (Denyer and Tranfield, 2009). SLR identifies the issues and strings better suited for making a first selection of articles. Therefore, the research questions presented in Section 2.9 have been addressed based on an SLR of extant literature.

However, SLR also has some disadvantages. For example, the SLR process is not able to automatically identify the dynamics in the evolution of knowledge so the results for the SLR process based on a static level of knowledge in a field may lead to different sets of the results by different researchers (Denyer and Tranfield, 2009). Moreover, in the interpretation process the identification of the evolution of concepts, albeit assisted by the small number of articles to read, always depends on the experience of the reader (Colicchia and Strozzi, 2012). Thus, the researcher needs to be careful using the SLR approach but this researcher believes that SLR has provided essential results for the literature review of this thesis.

2.2.1 Question formulation

Firstly, the definition of the scope for this study is presented in compliance with objectives and the underlying research questions and hypotheses. Denyer and Tranfield (2009) propose CIMO-logic (as “Context, Intervention, Mechanisms and Output”) to determine the boundary of the literature review. CIMO can be used to specify the four critical parts of a well-built systematic literature review question

(Denyer and Tranfield, 2009). The application of this logic to the context under study is stated as follows:

- *Context:* Which aspects of SSCM and SRES are of interest?
  What is the relationship between SSCM and SRES?
- *Intervention:* How will SSCM and SRES be measured?
  Which are important SSCM and SRES practices for organizations?
- *Mechanisms:* What are the mechanisms that explain the relationship between SSCM-SRES and outcomes?
  Under what circumstances are these mechanisms activated or not activated?
- *Outcome:* What are the impact of SSCM and SRES practices in organization?
  What outcomes would be important to organizations involved?

Regarding CIMO-logic, these logics were applied and used to answer all above questions; it was found that SSCM and SRES have received more interesting in supply chain context from practitioners' perspective than academics' perspective. CIMO logic was carefully considered in order to reduce pre-determined biases. Then, the increased number of research in the SSCM and SRES fields is characterized as context; effective practices and tools for SResSCM represent the interventions of interest; the mechanism of interest is research context of this thesis; and the expected outcomes are the supply chain improvement and organizational impact. Therefore, the main themes of interest are sustainability and resilience in supply chain (C), practices and measurement scale for SSCM and SRES (I), Thailand's electrical, electronic and automotive industry (M), and improved SC performance and impacted on organization performance (O).

The review content process was used to review relevant papers in the literature. Selected papers were investigated for differences or similarities in this process. The mechanism of interest was the organization of SResSCM processes, the expected outcomes being the enhancement of sustainability and resilience in supply chains.

2.2.2 Locating studies

The second phase of the SLR process is to locate the relevant studies. This study employed two main search engines, which were used to find existing contributions relevant to this study, i.e. Web of Science (www.webofknowledge.com) and ABI Inform Proquest (www.proquest.com). These databases were selected for the literature search because they have some of the largest repositories of business research and are typically used in literature reviews (e.g. Colicchia and Strozzi (2012), Durach et al. (2015), Mandal (2014), Martínez-Jurado and Moyano-Fuentes (2014)). Additionally, both databases include high quality journals (more than 8,000 in Web of Science and more than 9,000 in ABI Inform Proquest). These databases also support users with complete author, abstract, references and bibliographic data.

With regards to CIMO-logic, a total of eight keywords were defined and integrated into search strings. Keywords included: “sustainable/sustainability”; “resilient/resilience”; “short and long”; “impact”; “electric/electronic”; “performance”; and “Thailand”. Search strings were refined and discussed with two academics. By merging keywords through simple operators and Boolean logic, complex searches can be constructed in order to avoid too generic and wide results. There are eight search strings, as mentioned in Table 2.1. These search strings were entered in exactly the same way into both search engines used. During this step, research methodology and research gaps were explored. A point of saturation was considered to have been reached when the same articles continued appearing.

Table 2.1: Search strings and number of retrieved papers in web-base

Search string	Actual search strings	ABI Inform Proquest	Web of Science	Total
1	Sustainab* AND "Supply Chain" AND (short OR long) AND Impact* AND Electr*	440	390	830
2	Resilien* AND "Supply Chain" AND (short OR long) AND Impact* AND Electr*	52	38	90
3	Sustainab* AND Resilien* AND "Supply Chain" AND (short OR long) AND Impact* AND Electr*	30	10	40
4	Sustain* AND Resilien* AND supply chain AND performance	162	18	180
5	Sustainab* AND "Supply Chain" AND Thailand	45	16	61
6	Resilien* AND "Supply Chain" AND Thailand	10	4	14
7	Sustainab* AND Resilien* AND "Supply Chain" AND Thailand	6	1	7
8	"Performance" AND "Supply Chain" AND Thailand	52	46	98
	Total	797	523	1320

2.2.3 Study selection and evaluation

The systematic literature review in the SCM field, and SSCM and SRES in the literature field were applied to explore the most relevant papers. The following criteria, adapted from Newbert (2007), were employed to limit the search and increase the reliability of the literature review:

- Search for papers published in peer-reviewed journals;
- Search for papers written in English;
- Search for papers published in the time window from 2000 until the present to scope published papers for up-to-date information.
- Search for papers published in SCM journals and relevant journals dealing with SSCM and SRES, such as "*International Journal of Logistics Management, International Journal of Physical Distribution & Logistics, International Journal of Operation & Production Management, Journal of Cleaner Production, Supply Chain Management: An International Journal, International Journal of Operations & Production Management, International Journal of Production Research, Journal of Business Logistics, and Journal of Supply Chain Management, etc*".

However, due to the increasing number of published papers in the field of SSCM and SRES, it had to be established that papers published in these areas were consistent with this study. When collecting the data from the databases all information included in the citation file was imported to Endnote software package

in order to investigate the data management. The details included research title, author(s), journal, year of publication and abstract.

Figure 2.2 illustrates the process. A total of 1,320 papers were selected from Web of Science and ABI Inform Proquest. Then, duplicate papers were eliminated and the remaining papers were investigated using manual checks by researcher. The researcher deleted a further 208 papers from this step. Then, 1,112 papers were individually reviewed in a content check of article title and abstract by the researcher, the criteria for this step was to select papers related to SSCM and SRES in supply chain and business management fields. To increase the reliability of the research, 767 papers were reviewed again with a second review where decisions were based on the content of the introduction and conclusions section, with any additional information, and were inclusive rather than exclusive. A further 382 papers were removed because they were not relevant. According to this and the other search criteria described in this section, a final sample of 385 articles with reference to SSCM and SRES were identified.

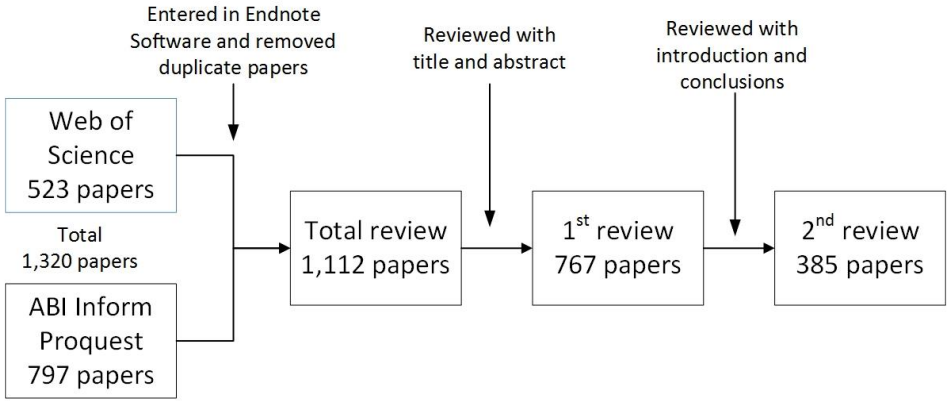

Figure 2.2: Article selected for this study

2.2.4 Analysis and synthesis

Different methods, including thematic analysis/synthesis, qualitative comparative analysis, qualitative meta-summary, meta-ethnography, qualitative meta-analysis, grounded theory and content analysis, can be considered for the synthesis of qualitative research (Garza-Reyes, 2015). Content analysis was considered the most

appropriate method for combining the results obtained from the systematic literature review conducted for this study. For the analysis, the papers were downloaded and imported to a Microsoft Excel spreadsheet, focusing on their publication data. Papers were reviewed and investigated for details such as author(s), year of publication, published journal, methodology applied, research contribution and future research. This step helped to separate and analyse all papers with the same criteria. In addition to the basic bibliographic information recorded in Endnote (i.e. year published, author(s), journal, etc.), each paper needed to answer certain questions, as below (Denyer and Tranfield (2009):

- "What is the main purpose of this article?"
- "What is the general idea of this article? "
- "How is it relevant to the research topic? "
- "What are the key research findings?"
- "What are the recommendations for further research?"

The purpose was to recognize published papers dealing with the concept of SResSCM. Given that the initial study took place in 2015, the constructs were updated to include relevant references up until the end of 2017 including a brief review of the key journals until the end of 2017 to ensure nothing was overlooked. These studies are easily identifiable in the reference list as they are dated after 2014. There were numerous fields for which papers had been published, i.e. business, management, environment, sustainability, marketing strategy, production management and industrial engineering. Therefore, the researcher concludes the SLR process was suitable for this study (Tranfield et al., 2003). Furthermore, these results presented the cross-disciplinary perspectives of the SLR process, including the different approaches for research topics (Burgess et al., 2006; Tranfield et al., 2003).

2.2.5 Reporting and using the results

The data from each paper were investigated and classified in different groups, being year, publisher, research methodology, dimension of SResSCM and business fields to identify the data from each paper. The results from the SLR were presented in two ways: (1) key trends and (2) key issues. These results will be provided in the next section.

Figure 2.3 demonstrates and summarizes the five phases of the SLR undertaken in this study, together with the methods and tools used to support every process. The SLR process provided more evidence as journal articles on SSCM, SRES, performance measurement, and SCM in Thailand.

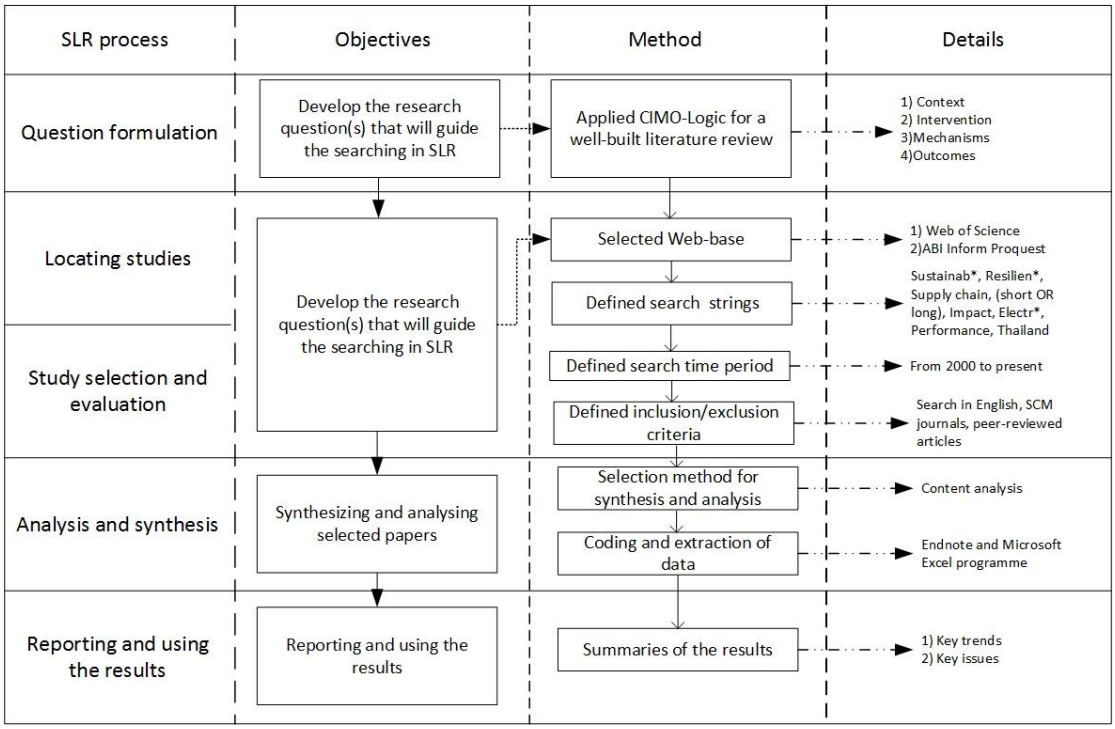

Figure 2.3: SLR phases, methods, details within this study

A total number of 385 articles complied with the selection criteria. These were all articles that, to a certain extent, referred to sustainability and resilience, as well as related topics, such as environment, economic and social issues, vulnerability and capability. The initial frequency analysis provided an overview of the quantifiable statistics on the final sample of 385 articles published before November 2016. In summary, the results lead to the next step; “Descriptive results”. The findings from

the SLR were demonstrated in two ways, as key trends and key issues, as described in the following section.

2.3 Key trends in SSCM and SRES

The analysis from each paper was identified and investigated in different groups in this section. The information from Endnote programme was entered into a Microsoft Excel spreadsheet with author(s), year of publication, research topic and journal name. Within Microsoft Excel, each journal was reviewed in more detail to answer the question from Section 2.2.4. The papers were in the field of SSCM, SRES, or performance measurement in SSCM and SRES. This process would help the researcher to summarize the current issues in SSCM and SRES in order to develop a new definition of SResSCM and performance measurement in SResSCM.

This section is classified by five criteria. The content of the papers was reviewed with a descriptive analysis: (1) how is the distribution of publications across the time period? (2) In which top ten journals are such articles published? (3) What research methodologies are applied? (4) Which dimensions of sustainability and resilience are addressed? (5) Which articles are most important for sustainability and resilience in the existing literature in the last decade? For these classifications, each paper was assigned to exactly one category. The selection of these categories used for descriptive analysis as following.

According to the SLR process, researcher used the time-frame period from 2000 onwards for researching papers. The analysis on publication years reveals a sharply growing trend of articles on these search strings over the past 15 years (Figure 2.4).

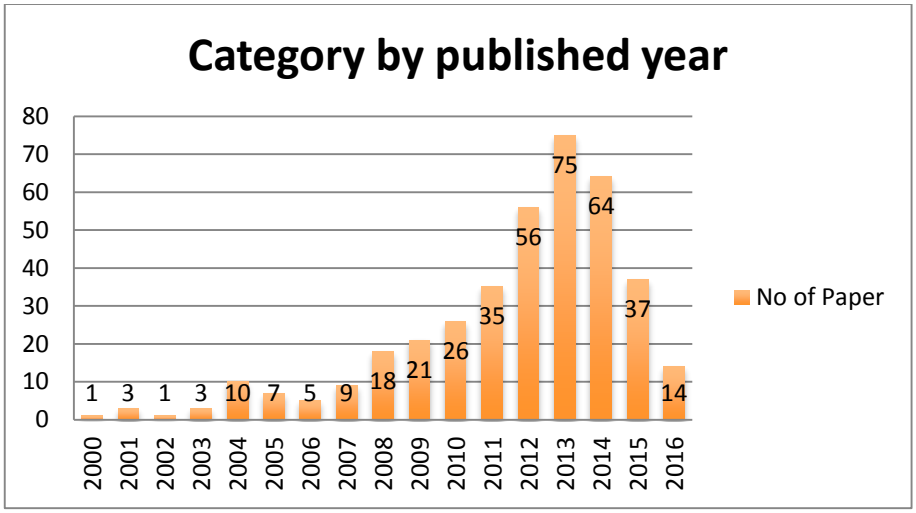

Figure 2.4: Number of publications per year from 2000 – 2016 (n = 385)

The first paper in this study was published in 2000. After that, there was a significant increase in published papers in the fields of SSCM and SRES. It was found that most of the papers were published between 2012 and 2015, with 232 papers (60%). Most papers were published in 2013, with 75 papers (19%). This concurs with other authors, SSCM and SRES being topics of interest for the past decade, as stated by Seuring and Müller (2008b), revealing a seven-fold increase from 2004 to 2013 (from 10 to 75). The literature on SSCM and SRES has slightly increased with this result, which can be interpreted as a sign of high acknowledgment in the scientific community. In general, the results indicate that the topic of SSCM and SRES gained special interest and popularity within the research community in 2013, as 19% (75 articles) of the publications were released in the period between 2000 and 2016.

This proposed the topic of sustainability and resilience as a relatively new and emergent research field. However, publication since 2013 has dramatically decreased, even though it was expected that it would continue to increase in the next few years. Moreover, the combination between SSCM and SRES is of interest to academia, as there are some journals, which are calling for papers on sustainability and resilience in supply chains, for instance, IEEE-TEM Special issue or IJOPM special issue.

The next category for this study is the ranking of the top 10 journals in which the papers were published (Figure 2.5). As SSCM and SRES are interesting fields, some journals have published these ideas more frequently than in previous decades. Most papers were published in the *Journal of Cleaner Production* and *Supply Chain Management: An International Journal,* offering a quantity of 41 papers. Moreover, there were some papers in the *International Journal of Physical Distribution and Logistics Management* (34 papers), *International Journal of Operations & Production Management* (26 papers), *International Journal of Production Economics* (26 papers), *International Journal of Production Research* (14 papers), *International Journal of Logistics Management* (12 papers), *Journal of Business Logistics* and *Journal of Supply Chain Management,* with nine papers. In addition, there were papers in *Resources Conservation and Recycling* (eight papers). Thus, it can be confirmed that SSCM and SRES are interesting research topics in different journals, and are not limited to sustainability journals or specific fields.

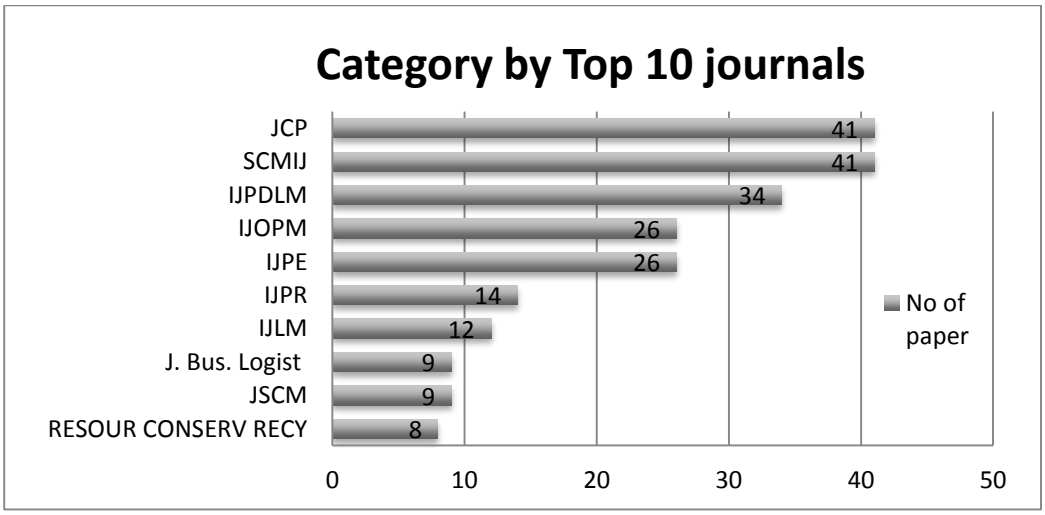

Figure 2.5: Category by Top 10 journals

Next, Figure 2.6 presents criterion that divides papers into five groups, related to the research methodology applied. Seuring and Müller (2008b) classified research methodologies into five, as: 1) theoretical and conceptual papers, 2) case studies, 3) survey, 4) modelling papers and 5) literature reviews. These criteria considered the methodology and methods used within each paper.

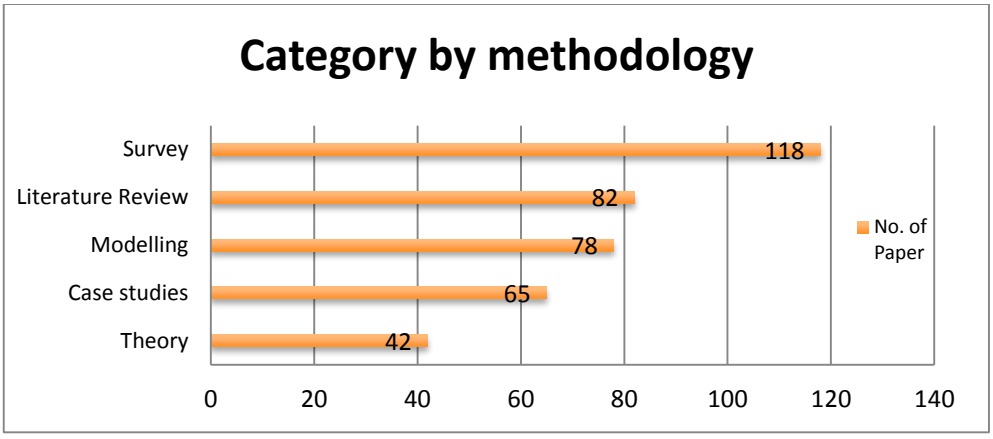

Figure 2.6: Category by Research Methodology

It is concluded that surveys are the methodology most commonly applied in the selected papers, with the highest number of 118 (31%). Furthermore, reviews of the literature and models of sustainability and resilience in supply chains were clearly interesting methodology for researcher as well, with the number of papers being 82 and 78, respectively. However, theory building in the sustainable and resilient supply chain management field was only shown to be about 10% for this research.

Further, Table 2.2 separates each paper within the SSCM and SRES dimensions. SSCM encompasses the well-known dimensions of environment, economic and social issues, named as triple-bottom-line (TBL), and SRES consists of supply chain risk management, or supply chain disruption and related fields. These papers were described singly, i.e. environment, economic, social or resilience, or two-dimensionally, i.e. environment-economic, social-resilience, environment-resilience, etc., or TBL, or all dimensions, i.e. environment-economic-social-resilience. This category shows the main dimension for each paper.

Table 2.2: Category by SResSCM dimensions

Dimension(s)	Number of papers
Environmental only	114
Economic only	5
Social only	14
Resilience only	92
Environmental – Economic	22
Environmental – Social	22
Environmental – Resilience	3
Economic – Social	2
Economic – Resilience	5
Social – Resilience	6
Environment – Economic – Social (TBL)	90
Environment – Economic – Resilience	0
Environment – Social – Resilience	1
Social – Economic – Resilience	0
Environment – Economic – Social – Resilience	9
Total papers	385

According to the aspect/dimensions stated in each paper, Table 2.2 shows the number of papers in individual dimensions as environment, social, economic and resilience. 30% of papers were published in the environment dimension (114 papers). Moreover, the number papers that discussed sustainability/triple bottom line (TBL) was about 90, or 23%, similar to the resilience papers, of which about 92 papers were published. Furthermore, an interesting point is there have been no papers published on environment-economic-resilience or economic-social-resilience at this moment. However, there was one paper on environment-social-resilience only. Therefore, this result justifies why this thesis is important since less than 10% of articles focus on SSCM/SRES factors, which are the critical themes being explored in this thesis.

Next, the last classification is citation value (CV). This classification used the number cited from each paper to calculate the amount of citation value. Citation value is defined as a ratio of individual citations to total citations (Al-Abdin et al., 2012); it includes important references in the relevant papers. The CV for each paper was calculated by use cited by each paper divided by the sub-total cited for all papers

and ranked into top 20 important papers related to citation value as shown in Tables 2.3. It can be seen that there were different papers from different periods of time; this shows that these papers are very important in the SResSCM field, in presenting the trend for SResSCM from 2000 to the present.

Table 2.3: CV for published papers

No.	Topic	Author(s)	Year	CV
1	A framework of sustainable supply chain management: moving toward new theory	Craig R. Carter and Dale S. Rogers	2008	10.12%
2	From a literature review to a conceptual framework for sustainable supply chain management	Stefan Seuring, Martin Muller	2008	4.73%
3	Do green supply chains lead to competitiveness and economic performance?	P. Rao and D. Holt	2005	3.81%
4	Performance measurement for green supply chain management	A. A. Hervani, M. M. Helms and J. Sarkis	2005	3.78%
5	Humanitarian logistics in disaster relief operations	K. Gyöngyi and M. S. Karen	2007	2.82%
6	Sustainable operations management	P. R. Kleindorfer, K. Singhal and L. N. Van Wassenhove	2005	2.64%
7	Extending green practices across the supply chain - The impact of upstream and downstream integration	S. Vachon and R. D. Klassen	2006	2.25%
8	Environmental management and manufacturing performance: The role of collaboration in the supply chain	S. Vachon and R. D. Klassen	2008	2.20%
9	Green supply chain management in China: Pressures, practices and performance	Q. H. Zhu, J. Sarkis and Y. Geng	2005	2.03%
10	Designing Resilient, Sustainable Systems	J. Fiksel	2003	1.89%
11	Greening the supply chain: A new initiative in South East Asia	P. Rao	2002	1.58%
12	Understanding the concept of supply chain resilience	S. Y. Ponomarov and M. C. Holcomb	2009	1.56%
13	Exploring future competitive advantage through sustainable supply chains	M. J. Markley and L. Davis	2007	1.37%
14	Supply chain specific? Understanding the patchy success of ethical sourcing initiatives	S. Roberts	2003	1.36%
15	BUILDING A MORE COMPLETE THEORY OF SUSTAINABLE SUPPLY CHAIN MANAGEMENT USING CASE STUDIES OF 10 EXEMPLARS	M. Pagell and Z. Wu	2009	1.34%
16	The moderating effects of institutional pressures on emergent green supply chain practices and performance	Q. Zhu and J. Sarkis	2007	1.20%
17	Manufacturing's role in corporate environmental sustainability: Concerns for the new millennium	J. Sarkis	2001	1.16%
18	A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach	K. Govindan, R. Khodaverdi and A. Jafarian	2013	1.02%
19	AN EMPIRICAL EXAMINATION OF SUPPLY CHAIN PERFORMANCE ALONG SEVERAL DIMENSIONS OF RISK	S. M. Wagner and C. Bode	2008	1.00%
20	ENSURING SUPPLY CHAIN RESILIENCE: DEVELOPMENT OF A CONCEPTUAL FRAMEWORK	T. J. Pettit, J. Fiksel and K. L. Croxton	2010	0.99%

In summary, this process led to 385 articles with the top 20 shown in Table 2.3. The most popular paper, which was cited by researchers about 10%, is paper from

Carter and Rogers (2008) with a framework of sustainable supply chain management. Moreover, it can be found that most of papers with high CV are in SSCM field about 15 papers from 20 papers; while there were four papers in SRES field and one paper discussed between sustainability and resilience. Thus, this is an opportunity for the researcher to study the relationship between SSCM and SRES and add more research in SResSCM field in the literature. In addition, these papers were used in this thesis as important references to develop the SResSCM framework so the researcher will focus on these papers first and then focus on the remaining papers.

Furthermore, there were three articles found post-2016 investigating sustainability related risk management: Giannakis and Papadopoulos (2016); Busse et al. (2017); and Multaharju et al. (2017). However, a review of the research in these articles did not materially affect the process or findings of this thesis.

2.4 Key issues in SSCM and SRES

SSCM and SRES are interesting topics at this time, according to the number of published papers in the literature. This study will investigate the relationship between SSCM and SRES emerging in the existing literature. Consequently, the study will integrate the definition of SSCM and SRES and create a new framework of "Sustainable and Resilient Supply Chain Management (SResSCM)" from the literature to offer better guidelines for implementation by organizations. It will then investigate suitable SResSCM practices based on the practitioner's perspective by suggesting appropriate practices to improve better performance in the supply chains. As mentioned in Section 1.2, the aims of this study are to improve sustainability and resilience in the supply chain, so the researcher needed first to examine current studies and define appropriate relationships for these two topics. Then, the initial framework and possible practices for SResSCM could be created and studied through the three-phase methodology of this study (Chapters 4 – 6), and discussed in Chapter 7. The results from the SLR process to develop key issues are explained below under different topics in order to study the current status of each topic.

2.4.1. Supply Chain Management

The concept of SCM has received increasing attention from academicians, consultants and business managers alike (Li et al., 2006). However, it has been considered from different points of view in different bodies of literature (Croom et al., 2000), such as purchasing and supply chain management, marketing, organizational theory, logistics and transportation, operations management and management information systems. According to Tan (2001), there are two paths of SCM research: 1) purchasing and supply chain management and 2) logistics and transport management. Therefore, the different definitions of SCM used by researcher mainly depend on the research path. The following sections will present more detail on SCM from the SLR results.

- *Definitions of SCM*

Traditionally, SCM has been defined as "the management of physical, logical, and financial flows in networks of intra- and inter-organisational relationships jointly adding value and achieving customer satisfaction" (p.7) (Mentzer et al., 2001). On the other hand, in contrast to traditional SCM, which focuses on economic and financial business performance, sustainable SCM is characterized by the explicit integration of environmental or social objectives, which extend the economic dimension to the triple-bottom-line (TBL) (Seuring and Müller, 2008b). This has been attributed to the interdisciplinary origin of SCM, conceptual confusion, and the evolutionary nature of the SCM concept. SCM can be provided in different contexts. Even so, Harland (1996) argued that "the term of supply chain has been a focus of organizations ever since its inception in the early 1980's, and the main objective of supply chain is to produce value in the form of products and services that are delivered to a customer" (p. S63). Considering the fact that the supply chain regards the product from the initial point of raw materials to transfer to the end-user, an important point on supply chains is the step towards the wider adoption and development of sustainability (Ashby et al., 2012).

Furthermore, economic sustainability helps to eliminate monetary risk, and increases profits for organizations when combined with efficient supply chains

(Fawcett et al., 2008). The main conventional economic performance indicators for SCM have been summarized as quality, speed, dependability, flexibility and cost (Gunasekaran et al., 2004). SCM is an established field of research and practice (Burgess et al., 2006). Moreover, SCM originates in part from the idea of reducing waste, because waste can reduce economic profitability (Sarkis et al., 2011). Another goal of SCM is to integrate both information and material flows seamlessly across the supply chain as an effective competitive weapon (Childerhouse and Towill, 2003). Then, the scope of logistics from the point of origin is to transfer the final product to the end-customer, as explained by Christopher (1998) in Figure 2.7, so supply chains involve information and materials flowing across a network of organizations, as shown in a generic manufacturing supply chain outlined by Vrijhoef and Koskela (2000) in Figure 2.8.

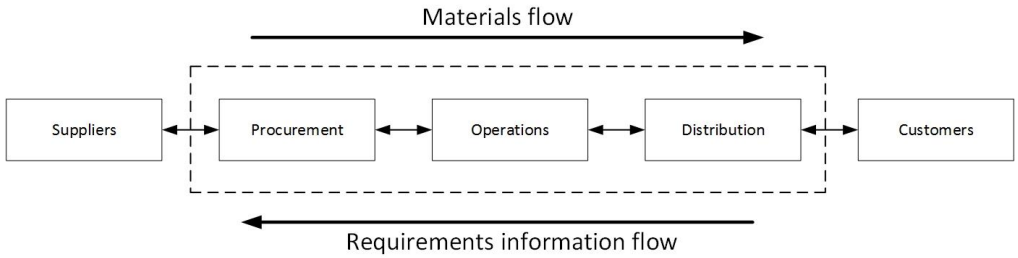

Figure 2.7: The logistics management process *(Source: Christopher (1998))*

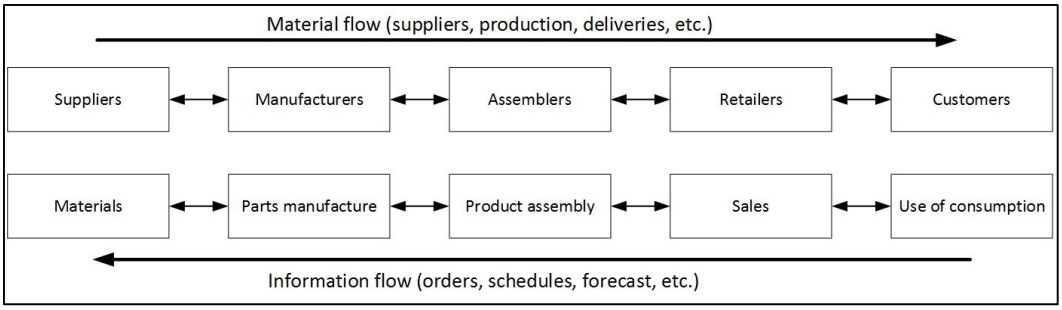

Figure 2.8: Generic configuration of a manufacturing supply chain *(Source: Vrijhoef and Koskela (2000))*

Definitions of SCM by some authors are presented in Table 2.4.

Table 2.4: Supply Chain Management definition

Author(s)	SCM definition
Houlihan (1985)	SCM is about addressing the imbalances due to conflicting objectives in marketing, sales, manufacturing and distribution by managing the trade-offs between supply policies, economics, of manufacturing and complexity.
Stevens (1989)	A connected series of activities which is concerned with planning, coordinating and controlling materials, parts and finished goods from suppliers to customer. It is concerned with two distinct glows (materials and information) thought the organization.
Harland (1996)	Supply chain management can be defined as "the management of a network of interconnected business involved in the ultimate provision of product and service packages required by end customers".
Cooper et al. (1997)	SCM is "an integration of key business processes from user through original product suppliers with the aim of providing products, services and information that add value for customers and other stakeholders".
Christopher (1998)	Supply chain is "a network of organizations that are linked through upstream and downstream relationships in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer.
Monczka et al. (1998)	SCM requires traditionally separate materials functions to report to an executive responsible for coordinating the entire materials process, and also requires joint relationships with suppliers across multiple tiers. SCM is a concept "whose primary objective to integrate and manage the sourcing, flow, and control of materials using a total systems perspective across multiple functions and multiple tiers of suppliers.
Tan et al. (1998b)	SCM encompasses materials/supply management from the supply of basic raw materials to final product (and possible recycling and re-use). SCM focuses on how firm utilize their suppliers' processes, technology and capability to enhance competitive advantage. It is management philosophies that extend traditional intra-enterprise activities by bringing trading partners together with the common goal of optimization and efficiency.
Handfield and Nichols (1999)	Supply chain management (SCM) is "all activities associated with the flow and transformation of goods from raw materials stage (extraction), through to the end user, as well as the associated information flow by integrate these activities through improved supply chain relationships to achieve a sustainable competitive advantage"
Christopher (2005a)	Supply chain management is the management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole.
Lambert (2008)	SCM is defined as "the integration of key business processes from end-user through original suppliers that provides products, services, and information that add value for customers and other stakeholder as supply chain management includes all business process within the supply chain from point of origin to point of consumption".
Jain et al. (2009)	Supply chain is " a dynamic process that encompasses the continuous flow of materials, funds and information across multiple functional areas within and between chain members.

There have been some developments of SCM definitions in the literature and these papers, although most tend to be the same. However, they help to scope the definition of SCM for this thesis. Therefore, the researcher defines SCM in this thesis as "*The management between supplier-manufacture-customer to produce product/information from upstream to downstream and also in reverse terms as well, to increase value added and customer satisfaction for the business***"** by combining SCM definition from previous section and provide an appropriate definition that related to all parties in supply chains. Thus, this SCM definition will lead this thesis to focus on all members along supply chains and guide organizations to improve better performance for supporting their customers.

- *Evolution of Supply Chain Management*

The literature suggests that a number of the main concepts of supply chain management have changed over different periods of time. For instance, Masters and Pohlen (1994) explained the evolution of logistics management and the role of logistics directors/managers within three periods as:

1. Time between 1960–1970: functional management, where purchasing, distribution and shipping are separately controlled within each function.
2. During 1980s: internal integration as the management of the supply chain functions of a single unit is unified, and becomes the responsibility of a single individual.
3. During 1990s: External integration as the management of supply chain functioning throughout the supply chain is unified, requiring combination between the linkages within the supply chain.

La Londe (1994) also explained the evolution of integration of logistics across three periods as:

1. Physical distribution: as the process to deliver or distribute goods/products that are controlled by the logistics manager/director.

2. Internal linkages: as the logistics managers/directors control the internal supply functions and physical distribution themselves.
3. External linkages: as the combination between upstream and downstream entities to increase the benefits of the supply chain by controlling the management of cooperation by logistics management.

The main integration model was developed by Ballou (2007) from the main constituent functions between the 1960s to 2000 (Figure 2.9). It showed the evolution of SCM that involved and integrated the approaches with the decade of total integration. SCM integrates further linkage as logistics with manufacturing, information technology (IT), marketing, sales and strategic planning (Ballou, 2007).

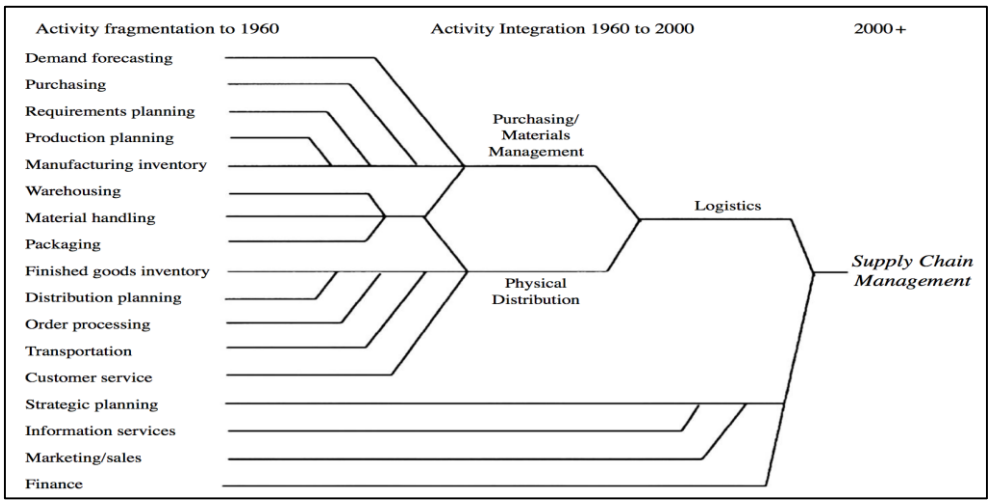

Figure 2.9: Supply chain management evolution *(Source: Ballou (2007))*

Porter (1985) provided an approach which related to the value chain concept, namely Porter's Value chain. This supports the awareness of logistics capability that leads to competitive advantage. Most organizations use such activities in their process to convert inputs to outputs. This concept can be categorized generally as primary activities and support activities. As advocated by Porter (1985), the primary activities are inbound logistics, operations, outbound logistics, marketing and sales, and services. On the other hand, the support activities are procurement, human resource management (HRM), technological and infrastructure as shown in Figure 2.10.

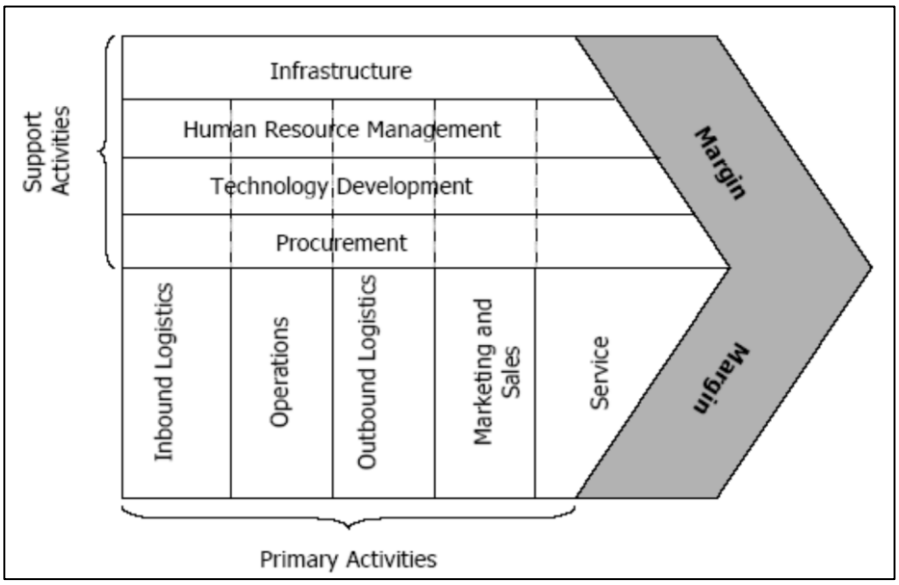

Figure 2.10: Porter's Value chain *(Source: Porter (1985))*

- *Advantages of SCM for manufacturers*

Throughout the generic and construction-related SCM literature, the SCM concept is referred to as a strategy to increase competitive advantage through the way organizations utilize their suppliers' processes, technology and capacity. SCM has advantages for manufacturers, enabling seamless supply chains, increasing profitability, establishing competitive advantage, and so on.

First of all, Gunasekaran et al. (2001) explained that supply chain practices and knowledge can help organizations to enhance or increase their profitability. Dierickx and Cool (1989) claimed that economies of scale can increase profitability by decreasing production costs with higher volume. Furthermore, improvement in the understanding of SCM would help supply chain practitioners to realize more profit and turn uncertainty into a manageable risk (Christopher, 2005). Next, SCM expands the terms of information sharing, incentive alignment and decision synchronization to adopt seamless supply chains and combined logistics functions, such as transportation partners transporting products directly to end-users (Holweg and Pil, 2008). Moreover, SCM helps organizations to enhance competitive advantage (Christopher, 2005; Tan et al., 1998a). Tan et al. (1998b) argued that ideally SCM should focus on total integration between all business entities in the

supply chain. A practical approach would be to examine suppliers and customers, because supply chains are complex in their achievement of full integration among all the supply chain members. Handfield and Nichols (1999) also discuss that the improvement of supply chain relations lead to competitive advantage.

Organizations also integrate strategic suppliers in collaboration with their new product development process, and apply the concept of SCM to enhance quality of product, delivery process and eliminate waste at the same time. In addition, Morgan and Monczka (1995) emphasized that it has enabled organizations to take advantage of their suppliers' strengths and technologies during new product development processes. Burt and Soukup (1985) found that the integration of suppliers during the design stage led to an increase in more alternative conceptual solutions for manufacturers, in choosing appropriate components and technologies and helping to design the assessment stage. As research taking place in the twenty-first century onwards, SCM has become a more significant strategic plan for organizations to improve and increase the quality of products/processes, customer service and competitive advantage (Tan et al., 2002).

- *Supply chain management practices*

SCM practices are a set of effective activities carried out across the supply chain network to encourage effective management of supply chains (Li et al., 2006). The relevant literature verifies different practices as dimensions of this construct: outsourcing, strategic supplier partnership, information sharing, continuous process flow, quality, purchasing, customer relationships, inter-organizational system use, core competencies, postponement, supply chain integration, geographic proximity, JIT capability, product modularity and cross-functional terms (Cooper et al., 1997; Donlon, 1996; Lee, 2004; Li et al., 2006; Tan et al., 1998b; Tan et al., 2002).

Cooper et al. (1997) presented a framework of SCM combined with the business process, management components and structure within the supply chain. Furthermore, Donlon (1996) proposed SCM practices within five dimensions as 1) supplier partnerships, 2) outsourcing, 3) cycle time reduction, 4) continuous process

design and 5) IT integration among network members to maximize the value in supply chain. Other SCM practices were proposed by Cooper et al. (1997), comprising eight practices, i.e. (1) Customer relationship management, (2) Supplier relationship management, (3) Customer services management, (4) Demand management, (5) Order fulfillment, (6) Manufacturing flow management, (7) Product development and commercialization, (8) Returns management. In addition, Li et al. (2006) explained SCM practices as a set of activities conducted in the organization to improve SCM effectiveness, including five aspects as: 1) strategic supplier partnership, 2) customer relationships, 3) the level of information sharing, 4) the quality of information sharing and 5) postponement.

Furthermore, there are some studies on SCM practices in the existing literature, for example, Thatte et al. (2013) studied the impact of SCM practices such as strategic supplier partnership, customer relationship and information sharing, on supply chain responsiveness and competitive advantage of an organization. The results from this study show that a higher level of SCM practices can lead to improvement in supply chain responsiveness and enhanced competitive advantage of an organization. They also found that supply chain responsiveness can have a direct, positive impact on the competitive advantage of an organization. Moreover, Hsu et al. (2009) studied the relationship between operational capability and organizational performance in SCM practices. They found that SCM practices mediate the impact of operational capability on performance, because they allow organizations to take advantage of manufacturing capabilities by leveraging the expertise and cooperation of key members of supply chains.

Furthermore, Sweeney et al. (2015) investigated the implementation of supply chain management theory in practice and found that, even though the level of SCM understanding was generally quite high, there is room for improvement in relation to how this understanding is translated into practice. Moreover, the results also showed that government support is an essential factor in adapting SCM from theory into practice.

Accordingly, SCM plays an important role for organizations at the present. Supply chain enables organizations to share information with suppliers and customers, developing teamwork within the supply chain as well. Thus, SCM is an approach that can help organizations to attain business goals in the future. In more recent years, the terms, sustainability and resilience have been applied in the supply chains context. Hence, organizations need to focus on their supply chains if they want to improve their sustainability and resilience.

2.4.2. Sustainable Supply Chain Management

The term, sustainability has been explained in different fields, such as operations management, engineering, social science and science (Linton et al., 2007). The study and practical application of sustainable supply chain management (SSCM) has often emerged in recent times (Beske and Seuring, 2014). The term, sustainability has been interpreted in several ways, ranging from an inter-generational philosophical position to a multi-dimensional term for business management by combining environment, economics and social approach to sustainability. The topic of sustainability in the context of SCM has been discussed in the literature using a number of terms. As Seuring and Müller (2008b) stated, the increasing number of published papers on green issues and SSCM during the period between 1990 to 2007 amounted to 191 papers and, by the end of 2010, a total of approximately 308 published papers (Seuring, 2013). SSCM is a growing field, and more research and accumulation of results are needed in the future (Touboulic and Walker, 2015). In an emerging stage, keeping the discussion going and the meanings open signifies a multiplication of ideas contributing to the broadening of the SSCM knowledge base. Ahi and Searcy (2013) proposed that, in parallel to the continued growth of research in sustainable supply chain management (SSCM), a more holistic view of sustainability and its integration with SCM has emerged and shows the growth of momentum for research in the area of SSCM.

- *Definitions of SSCM*

The term, sustainability initially emerged in the literature over two decades ago, and academics and practitioners have proposed numerous definitions of it ever since (Winter and Knemeyer, 2013). To cope with the concept of SSCM, this study follows the concept according to Carter and Rogers (2008), who defined SSCM as "the strategic achievement and integration of an organization's social, environmental, and economic goals through the systemic coordination of key inter-organizational business processes to improve the long-term economic performance of the individual company and its value network" (p.368).

Elkington (1997) is credited with popularizing the latter three dimensions, which he called the triple bottom line (TBL) principle (also known as the three pillars: profit, planet and people). As a sign of their sustainability practices, companies issue periodic TBL reports to their stakeholders. Thus, the framework suggested by Carter and Rogers (2008) (see Figure 2.11) that adapted the 'triple bottom line' concept from Elkington (1997), shows that sustainability consists of economic, environmental and social dimensions. Many organizations have applied sustainability strategies in their business goals as eco-design, corporate social responsibility, competitive advantage, or cost-saving. Therefore, to become more sustainable, organizations need to focus on these three aspects.

The existing literature review on SSCM contains the research by practitioners on a diverse set of topics related to green purchasing, purchasing ethics, re-manufacturing, safety management, supplier certification, carbon footprint and reverse logistics. Efforts to make supply chains more environmentally friendly have gained priority due to increasing threats arising from global warming and climate change (Shukla et al., 2009). In addition, Srivastava (2007) explained that "an organization must manage not only short-term financial results, but also the risk factors resulting from its products, environmental waste, and worker and public safety" (p.70). Furthermore, Winter and Knemeyer (2013) stated "the field of SCM has an inherent connection to sustainability, and it has been recognized that the

concept of sustainability extends to both the operational drivers of profitability and their relationship to people and the environment we all live in" (p.19).

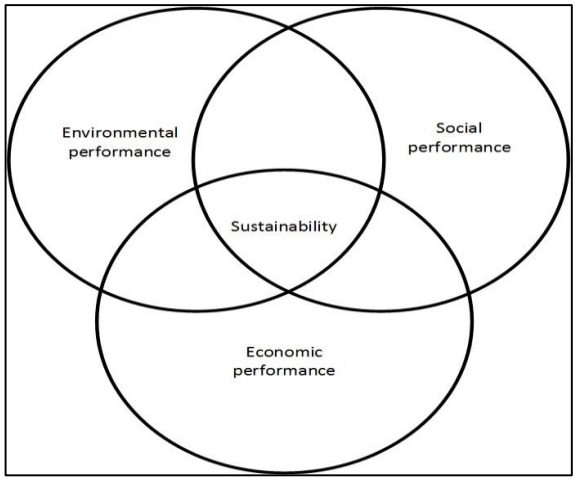

Figure 2.11: Sustainable Supply Chain Management framework *(Source: Carter and Rogers (2008))*

Authors have provided a variety of definitions for SSCM. Table 2.5 presents some of the key definitions chronologically from the existing literature review for this study. These show the development of SSCM definitions in this research field during the past four decades.

Table 2.5: Sustainable Supply Chain Management definition

Author(s)	SSCM definition
The World Commission on Environment and Development, (WCED, 1987)	Sustainability as "economic practices, which meet the needs of the present without compromising the ability of future generations to meet their own needs".
Green et al. (1996)	Green supply chain dynamics (ESCD) are a phenomenon where environmental innovations diffuse from a customer firm to a supplier firm, with environmental innovation defined as being either a product, process, technology or technique developed to reduce environmental impact.
Mentzer et al. (2001)	Sustainable supply chain is "the management of material, information, and capital flows as well as cooperation among companies along the supply chain while integrating goals from all three dimensions of sustainable development", i.e. social, environmental, and economic requirement that are perceived by stakeholder and customer to be more sustainable.
Zhu and Geng (2001)	Therefore, green purchasing – the integration of environmental considerations into purchasing policies, programs and actions – is critical for enterprise because it leads to eco-efficiency, cost-saving and improved public perception.

Table 2.5: Sustainable Supply Chain Management definition (CONT)

Author(s)	SSCM definition
Sikdar (2003)	Sustainability as "a wise balance among economic development, environmental stewardship, and social equity".
Zhu et al. (2005)	A sustainable supply chain demands that practices like environmentally friendly packaging, return of end-of-life and used, recycling, re-manufacturing and adequate waste disposal are enabled and are deemed to be important elements.
Srivastava (2007)	SSCM as 'the potential for reducing long-term risks associated with resource depletion, fluctuations in energy costs, product liabilities, and pollution and waste management."
Carter and Rogers (2008)	The strategic transparent integration and achievement of an organization's social, environmental, and economic goals in the systematic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains.
Seuring and Müller (2008)	The management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e. economic, environmental and social, into account, which are derived from customer and stakeholder requirements.
Pagell and Wu (2009)	Sustainable supply chain as "to be truly sustainable supply chain would at worst do no harm to natural or social systems while still producing a profit over an extended period of time".
Miemczyk et al. (2012)	Sustainable purchasing and supply chain management is the consideration of environmental, social, ethical and economic issues in the management of the organization's external resources in such a way that the supply of all goods, services, capabilities and knowledge that are necessary for running, maintaining and managing the organization's primary and support activities provide value not only to the organization but also to society and the economy.
Ahi and Searcy (2013)	Defined a new definition of SSCM by combining GSCM with SSCM in their paper as " The creation of coordinated supply chains through the voluntary integration of economic, environmental, and social considerations with key inter-organizational business systems designed to efficiently and effectively manage the material, information, and capital flows associated with the procurement, production, and distribution of products or services in order to meet stakeholder requirements and improve the profitability, competitiveness, and resilience of the organization over the short- and long-term".
Winter and Knemeyer (2013)	The integration of sustainability concepts with SCM concerns not only diverse business processes and activities across functional silos within a single company, but also corporation between parties across the network of relationships that form a supply chain.
Pagell and Shevchenko (2014)	SSCM is "the designing, organizing, coordinating, and controlling of supply chains to become more truly sustainable with the minimum expectation of a sustainable supply chain being to maintain economic viability, while doing less harm in social or environmental systems".

There are different SSCM definitions are used and provided in a vast body of literature. However, it can be seen that most of the existing literature pay attention on environment dimension rather than other dimensions. Therefore, a key consideration is the need to focus all dimensions into organizations' strategy by defining appropriate roles and responsibility. Therefore, the researcher defines SSCM for this thesis as "the management of supply chain with environmental, economic and social practices to improve more sustainable performance".

- *Dimensions of sustainable supply chain management*

In SSCM, environmental and social criteria need to be fulfilled by all the partners within the same supply chain, while it is expected that competitiveness would be maintained through meeting customer needs and related economic criteria (Taticchi et al., 2013). Furthermore, Linton et al. (2007) stated that "sustainability changes existing practices and creates new production and management system" (p.1080). As such, it is difficult for organizations to reach a balance between traditional efficiency-based performance and environmental benefits, which in turn influences green management at the business and functional levels (Handfield et al., 2005). Seuring and Müller (2008b) argued that in SSCM, environmental and social criteria need to be fulfilled by members within the supply chains, while it is expected that competitiveness would be maintained through meeting customer requirements and related economic criteria.

Some authors focused on a single dimension of SSCM, Srivastava (2007) emphasizing an ecological rather than sociological view of sustainability. Most organizations have acknowledged that SCM is the key to create a competitive edge for their products and/or services in an increasingly crowded market place (Jones, 1998). Teuteberg and Wittstruck (2010) created the "House of Sustainable supply chain" (p.143), based on the Triple Bottom Line (TBL) dimension, stated as the key factors to balance risk and compliance management (Figure 2.12). Besides, SSCM pays attention to sustainable development; therefore organizations would do well to enhance their green environment, corporate strategy, values and ethics along

these lines (Zailani et al., 2012a). By taking these measures, it will effectively protect the network against environmental and social threats and risks.

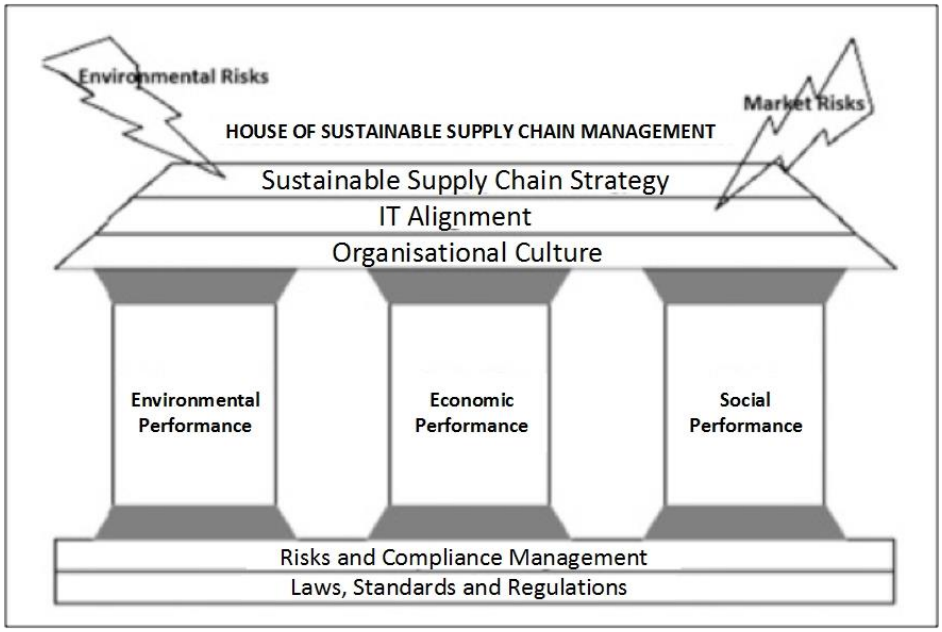

Figure 2.12: House of SSCM *(Source: Teuteberg and Wittstruck (2010))*

Most organizations have experiences in different sections, as internal pressure (i.e. caused by investors, employees, etc.), and external pressure (i.e. caused by legislators, customers, etc.) to implement environmental and social activities (Seuring and Müller, 2008b). Further, organizations can improve long-term economic benefits by their implementation (Carter and Rogers, 2008).

According to Table 2.2, the major proportion of articles relating specifically to the environmental perspective of SSCM (29.6%) related to green supply. Similarly, Ashby et al. (2012) reviewed SSCM literature and found that more journals published material on environmental dimensions than other dimensions. Moreover, even though environment and social dimensions were discussed in the literature, it can be seen that the environmental dimension has been better demonstrated than the social dimension in terms of practices and principles (Ashby et al., 2012). The dimensions of SSCM are explained under the following topics.

- *The environmental dimension*

The environmental dimension encompasses groups of objectives, plans and mechanisms, which enhance environmental responsibility and support the development of environmentally friendly technologies (Klassen, 2001). The greater proportion of sustainability pays attention to environmental issues (Lehtonen, 2004). In terms of green supply chain, organizations will collaborate with their suppliers to develop environmental performance in their processes and products (Zhu et al., 2005). In addition, Green Supply Chain Management (GSCM) combines environmental issues with SCM activities by exploring costs, benefits, opportunities and risks (Zhu et al., 2008) to control and eliminate waste from production (Handfield et al., 2005). However, Darnall et al. (2008) found in the existing literature that "firms adopting GSCM may evaluate 1st-Tier suppliers only, whereas the SCM function has an impact along the supply chain as 2nd, 3rd-Tier suppliers" (p.33). Hagelaar and Van der Vorst (2001) argued that "the term of environmental supply chain management (ESCM) is also utilized to explain the set of supply chain management policies held, actions taken and relationships formed in response to concern related to the natural environment" (p.400). Gimenez et al. (2012) argued that at the plant level, "environmental sustainability refers to the use of energy and other resources and the footprint organizations leave behind as a result of their operations" (p.150). Moreover, environmental sustainability is often related to waste reduction, pollution reduction, energy efficiency, emissions reduction, a decrease in the consumption of hazardous/harmful/toxic materials and a decrease in the frequency of environmental accidents (Gimenez et al., 2012). Yusuf et al. (2013) also discuss that "environmental sustainability is highly dependent on the development and use of new, clean and environmentally sustainable sources of energy" (p.503). It is essential that organizations should control their resources consumption at the permitted rate and protect against any possible pollutants.

Furthermore, climate change is one of the key goals and agreements provided by the Kyoto Protocol, with direct impact, especially on developing countries. Therefore, organizations need to manage and control their processes and products to reduce the emission from possible pollutants, i.e. GHG, carbon dioxide (CO_2),

hydrofluorocarbons (HFCs), methane (CH_4) perfluorocarbons (PFCs), sulphur hexafluoride (SF6) and nitrous oxide (N_2O). The Kyoto Protocol stated an aim of reducing emissions by 5% from 1990 levels, and was processed during the Kyoto commitment between 2008 and 2012. Based on the Kyoto Protocol, all countries are requested to apply these actions in their production. Developed countries and those in transition to being developed are specifically listed by the UN Framework Convention on Climate Change (UNFCC) (Yusuf et al., 2013).

Most papers pay attention to explaining environmental issues, for instance, life-cycle assessment, CO_2 emissions, or referring to all kinds of natural capital or resources such as water, energy and waste.

- *The social dimension*

The social dimension is dual, and refers to individuals and organizations. However, it is difficult to analyse social dimensions, because social phenomena are intangible (Lehtonen, 2004). Furthermore, Hall and Matos (2010) stressed that "the social dimension of sustainable development is emerging as the key challenge in SSCM, due to the fact that organizations have to involve a wide range of stakeholders with different goals, demands, and opinions that may interpret the same situation differently" (p.128). Furthermore, social sustainability consists of four major different categories of internal human resources, which encompass (1) practices (i.e. employment stability, health and safety); (2) external population (i.e. human, productive and community capital); (3) stakeholder participation (i.e. information provision and stakeholder influence issues); and (4) macro social performance issues concerning socio-economic and socio-environmental performance (Sarkis et al., 2010). Seuring (2013) stated that previous findings have confirmed that the social dimension needs much better integration with the economic and environmental dimensions.

Moreover, Pullman et al. (2009) explained that social sustainability shifts the focus to both internal communities (i.e. employees) and external costs. In addition, social sustainability means that organizations (and manufacturing plants) provide

equitable opportunities, encourage diversity, promote connectedness within and outside the community, ensure the quality of life and provide democratic processes and accountable governance structures (Elkington, 1997). Moreover, social sustainability aims to develop and sustain employees' quality of life without damaging the environment (Yusuf et al., 2013), and consists of certain standards, i.e. the political and economic rights of citizens, the rights of the communities in which the resources are located, proper and socially-conscious corporate governance structures, workers' rights, community culture, sustainable human development, etc.

The social dimension is one of dimensions mentioned in the existing literature. One could even argue that the term, corporate social responsibility (CSR) should be used in SSCM. It is evident that there is a relationship between business and society, as suggested by some authors (Broto Rauth, 2016; Harwood et al., 2011; Ki-Hoon and Ji-Whan, 2009; Lemke and Petersen, 2013).

- *The economic dimension*

Economic sustainability is usually well understood at the plant level, to be operationalized as production or manufacturing costs (Gimenez et al., 2012). Furthermore, Yusuf et al. (2013) cited that "economic sustainability works on achieving economic growth while protecting and safeguarding the environment and the individuals that live in the environment" (p.504). Therefore, this relationship between environment and social perspective can lead to long-term economic growth for organizations (Sarkis et al., 2011).

Moreover, Seuring (2013) explained that it is logical that economic issues are addressed in papers dealing with supply chain management, and that more often, total cost or net revenue are taken as indicators. However, there are not many papers that provide insights into what kinds of economic goals are being pursued. The assessment of sustainability with economic modelling on life cycle, as studied by Wood and Hertwich (2013), found that economic assessments need to be able to cover the innovative capacity of a product system, and to reflect on the

economy-wide implications of a technology beyond the direct costs associated with a functional unit.

Some papers have mentioned alternatives linking environmental performance with economic dimensions, for instance Bose and Pal (2012); Glock et al. (2012); Gotschol et al. (2014); Jayaraman et al. (2012); Lai et al. (2008); Mitra and Datta (2014); Rao and Holt (2005); Silvia and Orlando (2015); Tatsuo (2010); Zhu and Sarkis (2007). In addition, some journals have integrated economic and social dimensions in their articles, for instance, that of Quazi and Richardson (2012), who studied the linkage between corporate social responsibility (CSR) and corporate financial performance (CFP), and found that sample size and statistical technique play an important role in determining the link between CSR and CFP. By combining these two factors, they concluded that research methodology can be singled out as the major source of variation in the strength of the relationship between CSR and CFP. Tsai et al. (2009) concluded that "economic sustainability is not just about profitable returns but also ensuring that the activities of organizations do not result in any kind of environment or social degradation" (p.1408). In addition, it can be found that there is a lack of financial perspective, even where organizations have applied sustainability concept in their policies. Moreover, large organizations, government and international agencies need to support smaller organizations with financial and technical assistance (Yusuf et al., 2013).

- *Integration of the three dimensions*

The integration of all three dimensions plays a central role, but has rarely been addressed so far in related research (Seuring and Müller, 2008b). Previous findings have confirmed that the social dimension needs much better integration with the economic and environmental dimensions (Seuring, 2013). Conceptualizing sustainability in three dimensions seems to be widely accepted (Carter and Easton, 2011), and allows an easy comprehension of the integration of economic, environmental and social issues. Seuring and Müller (2008b) emphasized the need for increasing cooperation in the supply chain, if sustainability goals are to be reached. Hence, this should be reflected in related goals. A closer look at each

dimension is needed, to decide which goals are put forward (Seuring, 2013). Moreover, Sweeney and Park (2009) indicated that the development of economically and environmentally sustainable elements in supply chains is important for organizations, supply chains and policy levels.

Moreover, some published papers mentioned the integration of the three dimensions of TBL. For example, Wittstruck and Teuteberg (2012) explored the beneficial effects of certain activities on SSCM, and found that companies who communicate their SSCM activities externally attract more easily like-minded cooperation partners. They believe that organizations and decision-makers (practitioners) benefit from their model, as it enables them to better identify SSCM success factors in order to determine actions that lead to the overall success of SSCM, and to improve their decision-making, reflecting on how various factors contribute to possible benefits. As discussed by Gimenez et al. (2012), "the triple-bottom-line concept suggests that organizations not only need to engage in socially and environmentally responsible behaviour, but also that positive financial gains can be made in the process" (p.150). Thus, the sustainability concept is important for organizations at this time.

Furthermore, Winter and Knemeyer (2013) provided an overview of the existing research and suggested potential opportunities for academic inquiry, linked to the concept of SSCM. They found that "the existing literature is primarily focused on individual sustainability and supply chain dimensions rather than taking a more integrated approach" (p.18). Moreover, a study by Touboulic and Walker (2015) stated that theory-building efforts in SSCM remain scarce, with the predominance of a few popular imported macro theories (resource-based view (RBV), stakeholder theory, and institutional theory) having implications on the conceptualization of SSCM and the topics researched to date. In addition, Hall et al. (2012) studied the reasons why organizations should include sustainable development considerations in supply chains as a means of improving social and environmental impacts of production systems. They found that focusing on sustainable development elements independently is unlikely to find a satisfactory solution to sustainable

supply chains, and also that certain sectors, such as oil and gas, have a propensity to be socially exclusive, whereas others, such as biodiesel, are potentially socially inclusive, but encounter economizing pressures that may be at the expense of social and environmental performance.

From the existing literature review, it can be found that organizations focus on environment and social dimensions for short-term period, while pay attention on economic dimension for long-term period. Several articles refer the increased of SSCM adoption to be selected by organizations and included in supply chains. Thus, organizations should balance between environment, economic and social at the same time to overcome environmental and market risks. In line with the stakeholder theory, Sarkis et al. (2011) stated "Stakeholder theory suggests that companies produce externalities that affect many parties (stakeholders), which are both internal and external to the firm" (p.5). Hence, this thesis needs to study the understanding from Thai organizations about how to apply SSCM dimensions in their organization and supply chains.

- *Sustainable supply chain management practices*

A signal from SSCM practices can bring value to both organizations and the external environment (Zailani et al., 2012a). SSCM practices can lead to a reduction in the use of resources, materials and waste, thereby enabling better resource utilization, and playing a significant role in achieving the "triple bottom line" of social, environmental and economic performance, and, in turn, contributing to the development of sustainability by a country.

There are various SSCM practices currently, according to relevant literature and existing studies, for example, internal environmental management, product stewardship, green purchasing, reverse logistics, recycling, re-use, and re-manufacturing, ECO-design, cooperation with customers, corporate social responsibility, social responsible purchasing (SRP) and investment recovery. Some sustainable supply chain management practices can be explained as follows.

- Internal environmental management

Zhu et al. (2008) defined internal environmental management as "the practice of developing green supply chain management as a strategic organizational imperative through commitment and support of the imperative from senior and mid-level managers" (p.265). Internal environmental management has been the most widely adopted set of GSCM practices by Chinese manufacturers (Zhu et al., 2005). Zhu and Sarkis (2004) highlighted internal environmental management, including support from top and middle management as having the highest score among GSCM practice factors (including internal environmental management, ECO-design, external GSCM and investment recovery), which can bring about better environmental performance. Moreover, Green et al. (2012) proposed that the implementation of an environmental dimension, i.e. internal environmental management, has both a direct and indirect impact on GSCM practices.

- Green information systems

Green information systems help organizations to communicate important information to customers on ECO-design, production, packaging and transport along the supply chains (Green et al., 2012). Environmental sustainability in organizations can succeed based on their information systems, incorporating manufacturing, purchasing, selling and logistics process (Preuss, 2002). Esty and Winston (2009) defined green information as an information system which controls and manages environmental practices and outcomes in organizations. Information systems are also an important factor in helping organizations to maintain their survival in the supply chain (Green et al., 2012). Further, organizations have been applying information systems to provide tools, techniques and mechanisms in conjunction with their suppliers and customers. Moreover, organizations are required to develop and implement green information systems if they are to attain environmental sustainability (Green et al., 2012).

- Environmental/green purchasing

Normally, green purchasing is processed by organizations' suppliers to develop products which are more environmentally friendly than previously (Zhu et al.,

2008). Moreover, environmental purchasing considers the issue of sustainability in their purchasing of inputs on top of the traditional purchasing criteria, which only focused on cost, quality and delivery (Jimenez and Lorente, 2001). According to Hamner (2006), green purchasing activities among suppliers and buyers comprise 1) product content requirement, 2) product content restrictions, 3) product content labelling or disclosure, 4) supplier questionnaires, 5) supplier environmental management systems, 6) supplier certification and 7) supplier compliance auditing. According to these activities, supply chain managers should examine the raw materials and components which are delivered to their organizations (Zailani et al., 2012a). However, incorporating environmental considerations into the purchasing function may impose significant pressures and complications on the purchasing process, because purchasing must consider the supplier's environmental credentials, as well as cost, lead-time, quality and flexibility (Handfield et al., 2002). Interestingly, Green et al. (2012) indicated results showing that green purchasing has an impact on economic performance; however, it does not have an impact on environmental performance.

- Sustainable packaging

According to James et al. (2005), packaging is one of the essential factors in distributing products along the supply chain. Packaging can help to reduce waste and decrease environmental impact. However, packaging is not sustainable over the long-term because it mostly involves non-renewable resources, produces air emissions in production lines, and requires disposal within landfill (Zailani et al., 2012a). Moreover, Zailani et al. (2012a) found that environmental purchasing and sustainable packaging have a direct impact on organizational performance outcome, especially on economic and social outcomes.

- Cooperation/collaboration with customers

Organizations can develop products or processes which involve cleaner production, or produce environmentally friendly products by cooperating with their customers (Zhu et al., 2008). Furthermore, (Vachon, 2007) emphasized the key importance of collaboration with customers for organizations involved in logistics and

transportation activities. Green et al. (2012) established that there are direct impacts on environmental performance and indirect impacts on economic performance when organizations cooperate with their customers.

- ECO-design

Nowadays, manufacturers have been applying ECO-design to new products, which involve less consumption of materials and energy. They design products that can re-use, recycle or re-manufacture materials and parts, exempting hazardous products from the production process (Govindan et al., 2013; Zhu et al., 2008). ECO-design seeks to systematically integrate environmental aspects into product design, while maintaining all the necessary functional and safety requirements for consumers (Choi and Hwang, 2015). Karlsson and Luttropp (2006) also emphasized the importance of early product design decisions, because approximately 80% of all product-related environmental impacts can be identified during the design phase of product development. Manufacturers are now moderating this practice, developing designs that avoid environmentally hazardous components, and making it economically possible to save components that have high re-use value (Kleindorfer et al., 2005). Zutshi and Sohal (2004) cited that the ECO-design process usually starts with a life cycle assessment (LCA) as a tool to evaluate the environmental impact of a product over its entire life. Eltayeb et al. (2011) summarized the basic ECO-design activities in five areas: (1) design for the reduction or elimination of environmentally hazardous material, (2) design for re-use, (3) design for recycling, (4) design for re-manufacturing and (5) design for resource efficiency.

In conclusion, ECO-design establishes guidelines for design engineers pertaining to the environmental safety and soundness of a product. The impact of a product's entire life cycle is evaluated according to various aspects, i.e. alternative options for reducing waste and energy, recycling, or the elimination of product waste during manufacturing (Zailani et al., 2012b).

- Cleaner/sustainable production

The definition of cleaner production has raised a lot of interest during the past two decades. This definition was developed in Paris in 1989, by UNEP. Since then the definition has been expanded and sustainable development orientation has been added. For instance, Veleva et al. (2001) defined sustainable production as "the creation of goods and services using processes and systems that are non-polluting, conserving of energy and natural resources" (p.448). Moreover, Kjaerheim (2005) described cleaner production as "the process of using energy and resources efficiently to eliminate toxic raw materials, and to reduce both the amount and toxicity of all emissions and waste before they leave the production process" (p.338). The purpose of cleaner production management strategies are to: 1) increase the productivity of materials; 2) improve energy efficiency; 3) improve material environmental protection approaches; 4) apply preventive environmental protection approaches; 5) strive for sustainable use of natural capital and 6) achieve accordance with legal compliance (Glavič and Lukman, 2007). Furthermore, Halme et al. (2002) demonstrated the benefits of cleaner production as: improved efficiency, lower costs, conservation of raw materials, improved environment, better compliance with environmental regulations, a more cohesive working environment and better public image of an organization.

- Corporate social responsibility

Sarkis et al. (2010) explained that "social sustainability is strongly linked to corporate social responsibility (CSR) which comprises actions not required by law, but furthering social good beyond the explicit, transactional interests of an organization" (p.338). Therefore, CSR can be defined as the voluntary integration, by organizations, of social and environmental concerns in their commercial operations and in their relationships with interested parties (European, 2001). Moreover, Cruz and Wakolbinger (2008) argued that organizations can be held accountable for promoting and protecting the environmental, health and safety regulations of workers who make their products, regardless of whether they are direct employees or if they work for their supplier. Indeed, there is an increased pressure placed upon organizations by stakeholders, consumers, non-governmental

organizations (NGOs), local communities, legislation and regulation to implement CSR management systems across the supply chain (Govindan et al., 2013).

- Investment recovery

Investment recovery has received increased attention in recent years, as a growing number of environmental regulations impose greater responsibilities on OEMs for managing their end-of-life (EOL) products (i.e. the European Union's Extended Producer Responsibility) (Spicer and Johnson, 2004). Furthermore, investment recovery is assessed by the sale of excess materials in organizations, such as inventories, scrap, used materials and capital equipment (Zhu et al., 2008). Furthermore, investment recovery differs from ECO-design in that the former seeks to achieve a higher form of recycling/re-use by pursuing value-added recovery involving re-manufacturing (Guide, 2000). Chan et al. (2010) explained that investment recovery integrates obsolete EOL products and surplus assets back into the reverse logistics processes, so that these assets can be properly recovered or disposed of. Thus, investment recovery can help organizations to maximize cost-saving and value recovery, and has been successfully applied to a wide range of industries, such as computers and automobiles (Choi and Hwang, 2015).

In summary, in order to better interpret the current implementation, it is also important to investigate SSCM practices that most organizations currently used. It can be found that organizations implemented different SSCM practices from three dimensions as (1) environmental dimension as environment purchasing, ECO-design and sustainable production; (2) economic dimension as investment recovery and (3) social dimension as corporate social responsibility. From the literature review for this thesis, it emerges that the key challenges for an effective SSCM are (1) what SSCM practices were applied within organizations or supply chains and (2) how organizations implement SSCM practices since the same practices cannot be used to manage and support with different suppliers or customers. As Mary and Patrice (2015) explained "The firm's stakeholders play an important role in facilitating, and sometimes hindering, this aspect of effective supply chain management" (p.70). Thus, identifying and investigating the roles of various stakeholders within SSCM

practices has also been an application approach by the researcher utilizing the stakeholder theory. The definitions of SSCM sustainability dimensions and SSCM practices have been explained to enhance and develop the new definition of SResSCM as a goal of this study.

2.4.3. Supply Chain Resilience Management

The increasing interest in SRES can be traced to the frequent occurrence of man-made and natural disasters (Mandal, 2014). In 2011, Japan found that the earthquake and tsunami caused supply network disruption in some plants of TOYOTA in North America, leading to a shortage of parts (Cooper et al., 2011). Other examples have been stated in terms of supply chain disruptions, as mentioned in Section 1.2, such as Thailand's huge flood in 2011, which led to a disruption of the computer hard disk drive industry. As multinational personal computer (PC) manufacturer executives were investigating their supply network, they became concerned about how a supplier "deep in the supply network" might disrupt their operations (Kim et al., 2015). Hendricks and Singhal (2005) found that the announcement of a supply disruption lowered a firm's stock returns on average by 20%, six months after such an announcement. Similarly, they found that over the period from one year before, through to two years after a disruption is announced, stock prices declined by nearly 40%. Recent industry examples highlight the challenge that companies face in recovering from a disruption. Resilient firms are less vulnerable to supply chain disruptions, and are more capable of handling them when they do occur (Blackhurst et al., 2011; Pettit et al., 2013; Ponomarov and Holcomb, 2009; Sheffi and Rice, 2005). Moreover, some organizations appear to be able to weather the occurrence of hazardous events more effectively than others (Jüttner and Maklan, 2011). Such organizations are able to sustain themselves, returning to normality, or to a new state from which they can operate. Supply chain strategies such as agility, robustness and resilience have been discussed previously, in the realm of manufacturing and SCM (Wieland, 2013).

This study has developed a tool that will help supply chain leaders to measure their current levels of SRES. The next topic will conclude the current definition of SRES, SRES dimensions and SRES practices.

- Definitions of supply chain resilience management

Indeed, SRES has gained momentum as a competitive characteristic of supply chains due to increasing uncertainty on supply chain operations (Carvalho et al., 2012a) Furthermore, supply chains have become more vulnerable to a turbulent and risky business environment (Jüttner, 2005). Regarding this concept, SRES emerges as a dynamic capability that could be leveraged for effective SCRM. Organizations may enjoy being part of resilient supply chains in times of crisis, in the wake of disruptions, or when facing disastrous situations (Christopher and Peck, 2004a). This is true for both pre and post-management of supply chain risks, disasters and disruptions, as SRES allows supply chain members to both prepare and react to such disastrous incidents (Colicchia and Strozzi, 2012; Ponomarov and Holcomb, 2009). Thus, SRES is an important part of SCRM, although its utility reaches beyond the purpose of risk management (Ponomarov and Holcomb, 2009).

The concept of SRES is multidisciplinary and multidimensional. It is a subject of increasing importance in relatively new disciplines, such as risk management and SCM. Many authors have mentioned that SRES integrates the ability to prepare for unforeseen disruptions with the ability to respond and recover from them faster than competitors (Chopra and Sodhi, 2014; Christopher and Peck, 2004a; Jüttner and Maklan, 2011; Rice, 2011). Furthermore, Hendricks and Singhal (2005) stated that "organizations often do not react and recover quickly enough from the negative consequences of risk events" (p.35). Moreover, some articles highlighted that "SRES can create a sustainable competitive advantage by continuously adapting and developing capabilities to make a supply chain more resilient" (Hamel and Valikangas, 2004; Pettit et al., 2013; Ponomarov and Holcomb, 2009). Existing research suggests that resilience is an effective way to manage risk and recovery from supply chain disruption (Blackhurst et al., 2011; Chopra and Sodhi, 2014). Resilience may be the key to an organization's ability to handle supply chain

disruptions, but there has been little research to explain how organizations develop resilience to supply chain disruptions (Blackhurst et al., 2011).

The first definition of supply chain resilience was made in the United Kingdom, by CranfieldUniversity (2003). They explored the UK's industrial knowledge base concerning supply chain vulnerabilities, and found that (1) supply chain vulnerability is an important business issue; (2) little research exists on supply chain vulnerability; (3) awareness of the subject is poor and (4) a methodology is needed for managing supply chain vulnerability. Moreover, the studies by Christopher and Peck (2004b) confirmed that SRES can be created through four key principles: (1) resilience can be built into a system in advance of a disruption; (2) a high level of collaboration is required to identify and manage risks; (3) agility is essential to react quickly to unforeseen events and (4) the culture of risk management is a necessity.

Moreover, Sheffi and Rice (2005) noted that it is important for organizations to build resilience in order to deal with unforeseen and unquantifiable risks and proposed to consider SRES as a part of the organization's strategic role since the uninterrupted flow of materials and products is crucial to competitiveness and organizational success. Sheffi (2005) verified the ways in which organizations can recover from high-impact disruptions and focused on actions to lower vulnerability and increase resilience.

Furthermore, Carvalho et al. (2012a) argued that "the competitiveness of organizations and supply chains depends not only on reduced cost, improved quality, reduced lead time and increased high service level, but also on their ability to prevent and defeat the myriad disturbances that attack their performance" (p.60). This means that supply chains should be resilient. It confirms SRES is the process to prepare and recovery supply chain after disruption happened. Ambulkar et al. (2015) discussed that resilience allows organizations to manage supply chain disruption and continue to deliver their products and services to the customer.

Sheffi (2005) argued that resilience is no longer concerned only with the ability to manage risk, but is a capability that enables an organization to manage risks better than its competitors, even profiting from disruptions. The concurrent discussion on risk management with supply chain resilience has recently triggered a debate about the latter. For example, Jüttner and Maklan (2011) explored the apparent ability of some supply chains to recover from inevitable risk events more effectively than others, which has more recently triggered a debate about supply chain resilience (SRES). SCRM focuses on the identification and management of risks for the supply chain in order to reduce its vulnerability (Jüttner et al., 2003), whereas SRES pays attention to developing the adaptive capability to prepare for unexpected events and to respond to disruptions and recover from them (Ponomarov and Holcomb, 2009). Thus, SRES is based on the underlying assumption that not all risk events can be prevented (Jüttner and Maklan, 2011).

However, the literature gives no clear consensus on the definition of SRES. The different definitions in the SRES field by various authors are shown in Table 2.6.

Table 2.6: Supply Chain Resilience Management definition

Author(s)	SRES field
Svensson (2000)	A conceptual framework for the analysis of inbound logistic vulnerability consists of two principal dimensions and four vulnerability approaches, which categorize of disturbances and sources of disturbance.
Svensson (2002)	Defined supply chain vulnerability as "unexpected deviations from the norm and their negative consequences".
Christopher and Peck (2004a)	Defined resilience as the ability of a supply chain to return to its original state or move to a new, more desirable state after being disturbed.
Peck (2005)	Resilience means the ability to react to an unforeseen disturbance and to return to their original state or move to a new, more advantageous one after suffering the disturbance.
Sheffi and Rice (2005)	Defined resilience as the ability of a company to bounce back from a disruption and can be achieved by either creating redundancy or increasing flexibility.
Fiksel (2006)	Defined supply chain resilience as "the capacity for a firm to remain, adapt, and produce in the face of turbulent change".
Tang (2006)	Resilience is a strategy that enables operations to sustain during a major disruption and to recover quickly afterwards.
Azevedo et al. (2008)	Defined SC vulnerability as "the incapacity of the SC, at a given moment, to react to the disturbances and consequently to attain its objectives".
Longo and Oren (2008)	Defined resilience as a property that allows a supply chain to react to internal/external risk/vulnerabilities, quickly recovering an equilibrium state capable of guaranteeing high performance/efficiency.

Table 2.6: Supply Chain Resilience Management definition (CONT)

Ponomarov and Holcomb (2009)	Defined SCRES as " the accommodative capability of the supply chain to plan for surprising event, react to disruptions, and recover from them by remaining continuity of operations at the desired level of connectedness and control over structure and function".
Pettit et al. (2010)	SRES is the capability to anticipate and overcome supply chain disruption.
Blackhurst et al. (2011)	SRES is a firm's ability to recovery from supply chain disruptions quickly.
Jüttner and Maklan (2011)	Resilience defined by flexibility, velocity, visibility, and collaboration capabilities.
Li et al. (2011)	Defined SME resilience as the capability to self-renew over time, to maintain status quo or move to a new desirable state after (or before) being disturbed.
Murino et al. (2011)	In the material sciences, resilience represents the ability of a material to reacquire its original shape after a deformation, while in the business sector; resilience refers to the ability of a company to resist a serious damaging event.
Soni et al. (2011)	SCRES "is a network-wide, inter-organizational concept, its powerful potential have to assume the attitudinal tendency of the parties to line up forces in the case of risk event".
Zhao et al. (2011)	Defined resilience as the ability to maintain operations and connectedness under the loss of some structures or functions (i.e. removal of nodes).
Wieland (2013)	Resilience is the right strategy in the presence of both high probability and high-impact risks.
Chowdhury and Quaddus (2014)	Defined SCRES as the capability of a supply chain to reduce the impact of disruptions through developing required level of readiness, quick response, and recovery ability.

Table 2.6: Supply Chain Resilience Management definition (CONT)

Scholten et al. (2014)	Resilience in supply chain context, defined as an ability of supply chains to recover from inevitable and unexpected disruptions, i.e. resilience in disaster management defined as an ability of an individual, a household, a community, a country or a region to withstand, adapt, and quickly recover from stresses and shocks.
Ambulkar et al. (2015)	A firm's resilience to supply chain disruption is defined as the capability of the firm to be alert to, adapt to, and quickly respond to changes brought by a supply chain disruption.
Nils-Ole et al. (2015)	A definition of SCRES, that relates to social and economic dimensions, is "the supply chain's ability to be prepared for unexpected risk events, responding and recovering quickly to potential disruptions to return to its original situation or grow by moving to a new, more desirable state in order to increase customer service, market share and financial performance".

As presented in Table 2.6, there are several definitions of SRES from the relevant literature. Building on the above-cited references and other papers included in the literature review, the researcher can derive the main reason to the adoption of SRES in organizations is to mitigate risk for organizations and supply chains and also improve better supply chain performance for a long term. As SRES is also in line with contingency theory, which suggests that an optimal course of action is dependent on the internal and external situation of organizations. Therefore, this thesis built SRES framework related to contingency theory. In this sense, "the ability or strategy that support organizations to prepare, maintain and react to overcome supply chain disruption and quickly recovery their supply chain to their original state" is seen as a key point for SRES concept for this thesis. Moreover, there are various dimensions of SRES from the literature, so the next section will present the results of SRES dimensions from SLR approach for this study.

- Dimensions of supply chain resilience management

There are various studies about SRES framework in the literature. For example, Soni et al. (2011) developed a supply chain resilience framework, as shown in Figure

2.13. According to this framework, to improve SRES, SCs should have capabilities such as flexibility, adaptability, collaboration, visibility and sustainability. The elements included in the framework are analysed in the existing literature (Soni et al., 2011).

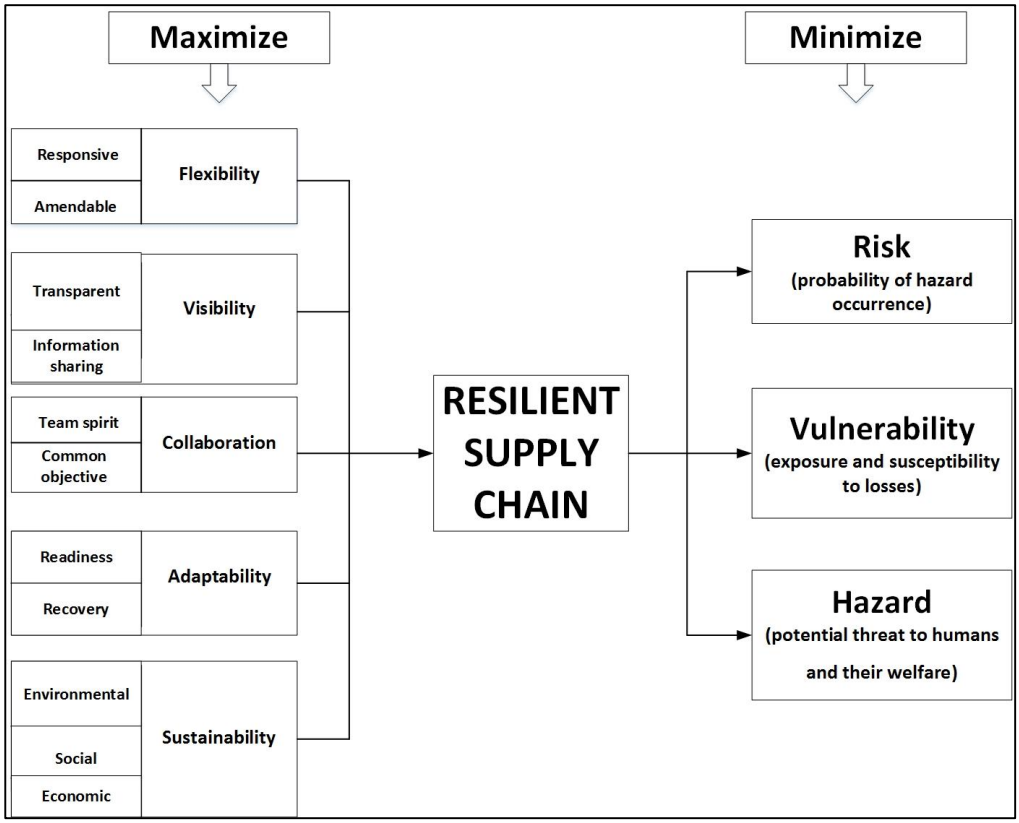

Figure 2.13: Framework for supply chain resilience *(Source: Soni et al. (2011))*

Furthermore, Ponomarov and Holcomb (2009) proposed the conceptual framework of the relationship between logistics capabilities and supply chain resilience with a macro-level model incorporating some of the concepts discussed in their research (Figure 2.14) The proposed model addresses the relative importance of specific logistics capabilities during each of three phases of supply chain resilience: readiness, response and recovery. Three psychological principles of resilience, defined as control, coherence and connectedness, are also part of the supply chain resilience framework. Figure 2.14 provides additional important information in risk management concept during managerial decisions, which managers can use this process in supply chain disruption for responding disruptive events to be more effectively and also this framework helped to increase confidence to managers.

However, this model still needs to be tested and developed by the academics, which will assist organizations and supply chains to define the extent to which dimensions of SRES should be developed.

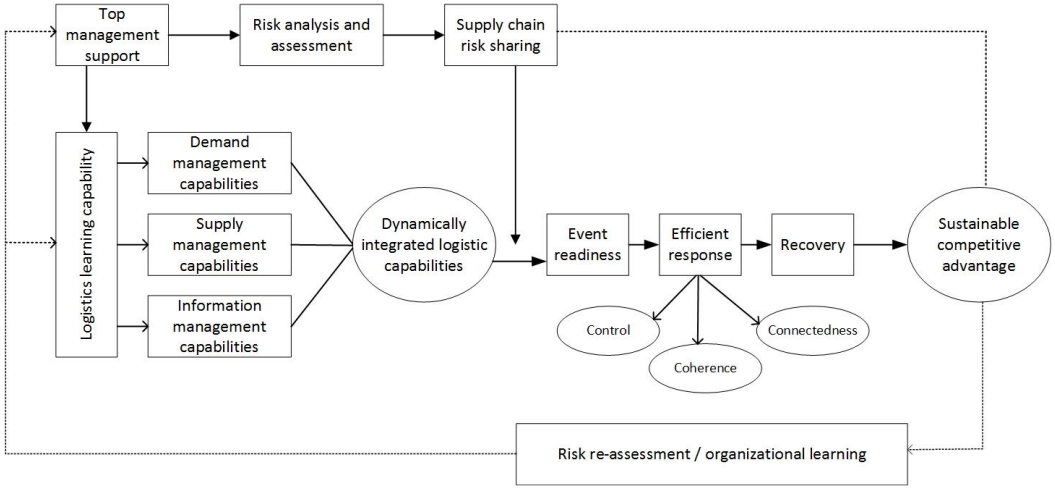

Figure 2.14: Conceptual framework of the relationship between logistics capabilities and supply chain resilience *(Source: Ponomarov and Holcomb (2009))*

In addition, Blackhurst et al. (2011) proposed a framework of supply resiliency (Figure 2.15). They explained resiliency enhancers are created by combining both tangible resources (i.e. physical capital resources) and intangible resources (i.e. human capital), and organizational and inter-organizational capital resources. Several empirical generalizations were derived from the research findings, which address specific characteristics that match, enhance or reduce supply resiliency.

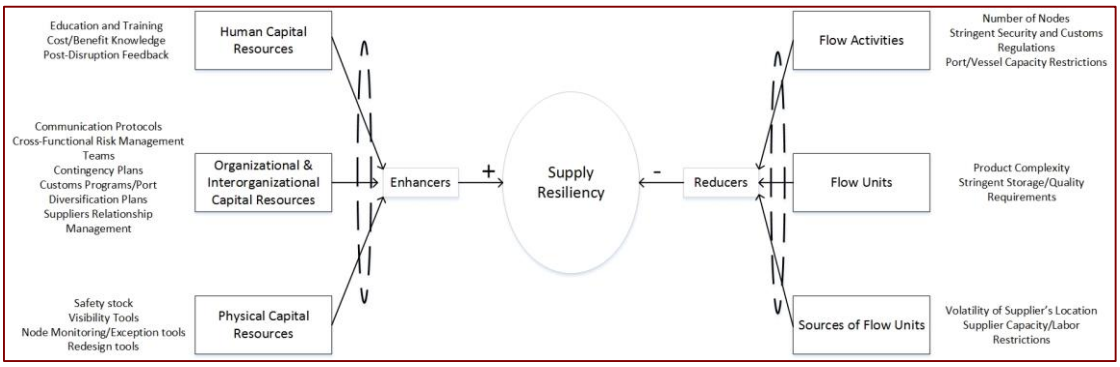

Figure 2.15: Framework of supply resiliency *(Source: Blackhurst et al. (2011))*

There is some research on SRES in matrix form, which has been studied by Blackhurst et al. (2011) and Wieland (2013) (Figure 2.16). Blackhurst et al. (2011)

summarized the resilient assessments in a supply resiliency matrix, which captures the various levels of risk in the supply chain. Each quadrant is explained as follows: (1) vulnerable supply chain, which has low resiliency enhancers and high resiliency reducers; these supply chains are particularly vulnerable, and even minor disruptions may have a severe impact on a firm's operations; (2) volatile supply chains have high resiliency enhancers and high resiliency reducers, which makes them extremely unpredictable and hard to manage; (3) sensitive supply chains have low resiliency enhancers and low resiliency reducers, where small disruptions could increase in severity and propagate both upstream and downstream within the supply chain; (4) resilient supply chains have high resiliency enhancers and low resiliency reducers, which is the ideal situation. Resilient supply chains are able to absorb disruptions and return to stable conditions quickly (Sheffi and Rice, 2005), which could give organizations a unique competitive advantage.

On the other hand, Wieland (2013) placed the risk matrix with an appropriate supply chain strategy falling into four kinds: (1) robust supply chain is the right strategy in cases in which the probability of risk is high and the risk impact is low; (2) agility supply chain is the right strategy when the probability of risk is low and the risk impact is high; (3) resilient supply chain is the right strategy in the presence of both probability and high-impact risks and (4) rigidity supply chain is the right strategy if probability and risk impact value are low.

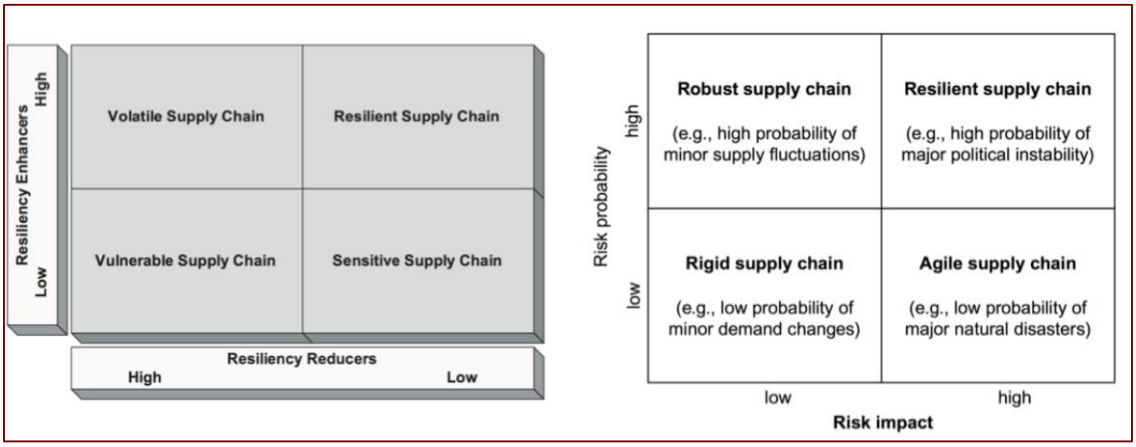

Figure 2.16: Supply chain and risk matrix *(Sources: Blackhurst et al. (2011) and Wieland (2013))*

Furthermore, Mandal (2014) reported a comprehensive review of SRES articles published in international journals during the period 1980 – 2012, and argued that there is a large scope of research to address the issues in risk management, supply chain design, sourcing strategies, green practices, sustainable competitive advantage, supply chain security, supply chain performance and supply chain resilience. Figure 2.17 states the broad research areas attached to SRES, based on the study of Mandal (2014).

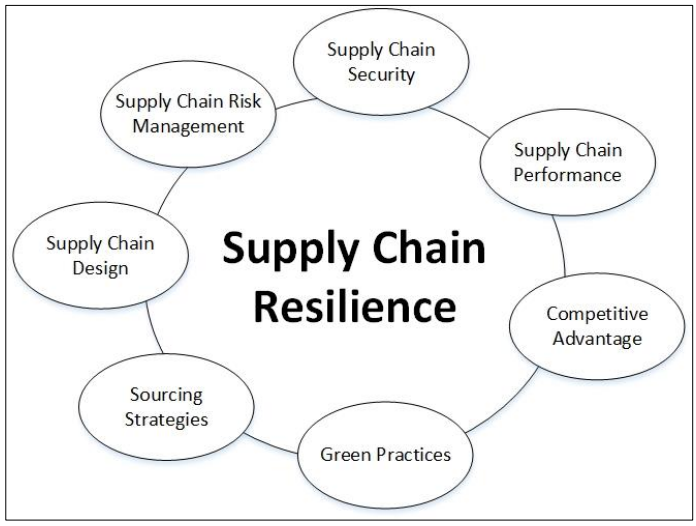

Figure 2.17: Supply chain resilience and adjoining paradigms *(Source: Mandal (2014))*

However, SRES sources were identified using different categories, grouped as i) vulnerabilities and capabilities, ii) robustness and agility, iii) readiness, response and recovery. Firstly, there was an interesting point from Pettit et al. (2010), who explained that vulnerabilities and capabilities are two constructs in the SRES context, as shown in Figure 2.18. Pettit et al. (2010) developed "the resilience fitness spaces" (p.8), and proposed that organizations should move in the zone of Balanced Resilience, with balance between two constructs, i.e. vulnerabilities factor, being the fundamental factors that make an enterprise susceptible to disruption, and capabilities factor, being the attributes that enable an enterprise to anticipate and overcome disruptions. They identified the sources of risk with definition and sub-factors in seven categories of vulnerabilities and 14 categories of capabilities.

Figure 2.18: Resilience fitness space *(Source: Pettit et al. (2010))*

Secondly, some authors discussed robustness and agility to improve SRES. Durach et al. (2015) argued that "a reactive strategy is usually referred to as agile supply chains, a proactive strategy is usually referred to as robust supply chain, and SRES corresponds to a balance between both reactive and proactive strategies" (p.119). Organizations need to prepare and implement the strategy that is most appropriate for each situation. Moreover, robustness in supply chain refers to the principles of adopting lean thinking, building a culture of quality awareness and control, including velocity, while SRES is more concerned with building a culture facilitating risk management at all points, and inducing acceleration and deceleration in supply chains (Christopher and Rutherford, 2004; Mandal, 2014).

Finally, in terms of readiness, recovery and response dimensions, is related to the studies of Nils-Ole et al. (2015), who found that SRES definitions can comprise four phases: (1) readiness to encounter an uncertain and turbulent business environment, (2) response, as the return to the original state after disruption (a central element in SRES), 3) recovery, as being prepared and avoiding potential threats and (4) growth, as reflecting the development nature of SRES in terms of moving to a new state and improved position after being disturbed. Moreover, the adaptive resilience capability has been structured along three distinct disruption

phases in the supply chain: readiness, responsiveness, and recovery (Sheffi and Rice, 2005).

For this thesis, to develop SRES in organizations, many researchers have developed different models and strategies. As mentioned above, the researcher summarized the dimensions of SRES that were found from existing literature as the combination between risk management, contingency plan and mitigation strategies, vulnerabilities and capabilities factors, tangible and intangible sources, supply chain disruption, reactive strategy (agile) and proactive strategy (robust). Therefore the researcher refers the interested reader to Pettit et al. (2010) and Pettit et al. (2013) for a thorough review of SRES practices. In line with the contingency theory, the best SRES dimensions may depend on the chosen strategy of the focal firm, the structure of supply chain (as suppliers, customers and sources of uncertainty) and other factors. Therefore, before organizations selecting a SRES strategy, it is first necessary to understand SRES dimensions and sources of uncertainty and then implementing the best appropriate SRES practices for reducing the level of uncertainty. The next section will present about SRES practices and processes from the literature review for this study.

- Supply chain resilience practices and processes

According to the SLR in this study, the concept of SRES has not yet been properly formed, specific strategies that increase SRES are unknown, and thus organizations have little guidance on which actions are most effective. The lists below are examples from others studied to date.

Christopher and Peck (2004a) proposed the following principles to design resilient supply chain in five steps: (1) Select SC strategies that keep several options open; (2) Re-examine efficiency vs. redundancy trade off; (3) Develop collaborative working; (4) Develop visibility; (5) Improve SC velocity and acceleration. This increases an organization's ability to respond to disruption, and enables the network to return to its original configuration with a positive impact on supply chain performance (Christopher and Peck, 2004a). However, designing a supply

chain with an adaptive capability to recover from disruption requires long-term collaboration between the organization and its supply chain, along with large-scale investments (Ponomarov and Holcomb, 2009).

There are two main manifolds of resilient strategies, which can protect the movement to undesirable situations in SCs (Haimes, 2006), i.e. (1) to recover the desired values state of a system that has been disturbed, within an acceptable time period and at an acceptable cost; and (2) to reduce the effect of the disturbance by changing the consequence level of a potential threat.

Pettit et al. (2010) proposed an SRES framework with vulnerabilities and capabilities. The sources of change are invoked by seven categories of vulnerabilities as: “Turbulence, Deliberate Threats, External Pressures, Resource Limits, Sensitivity, Connectivity, and Supplier/Customer Disruptions” (p.9). Moreover, these vulnerabilities should be counterbalanced with the following managerial controls that create supply chain capabilities: “Flexibility in Sourcing, Flexibility in Order Fulfillment, Capacity, Efficiency, Visibility, Adaptability, Anticipation, Recovery, Dispersion, Collaboration, Organization, Market Position, Security, and Financial Strength” (p.10). The balance of vulnerabilities and capabilities should be measured to assess the current level of SRES (Pettit et al., 2010; Pettit et al., 2013).

Moreover, the management of SCs should apply resilience when they design their SC characteristics, because the performance recovery from disruption events is based on the development of responsiveness capabilities, which are redundancy and flexibility (Carvalho et al., 2012b). Moreover, Tang (2006) suggested nine SC design strategies, which work more efficiently and effectively to overcome disturbance as follows: (1) postponement; (2) strategic stock; (3) flexible supply base; (4) make and buy trade-off; (5) economic supply incentives; (6) flexible transportation; (7) revenue management; (8) dynamic assortment planning and (9) silent product rollover. Furthermore, Soni et al. (2014) proposed a model using graph theory which holistically considers all the major enablers of resilience. Ten

enablers of supply chain resilience are explored as: (1) agility; (2) collaboration among players; (3) information sharing; (4) sustainability in supply chain; (5) risk and revenue sharing; (6) trust among players; (7) supply chain visibility; (8) risk management culture; (9) adaptive capability and (10) supply chain structure.

Moreover, Nils-Ole et al. (2015) theorized that "SRES can be quantified through three essential performance metrics that enable reporting on how severe a disruption impact is and how an organization's SRES performs: 1) customer service; 2) market share; and 3) financial performance" (p.107). Similar to Wu et al. (2013), a timeline can illustrate the impact before, during and after a disruption to measure SRES and display how quickly a firm has recovered.

Supply chains are facing unexpected situations that increase their vulnerability to disturbances. Some disruptions can be assessed in advance and some cannot. Thus, supply chains must be resilient to survive. SC managers need proactive capabilities to predict the disruptions in advance and to develop resilience capacity for mitigating the disruptions (Peck, 2005). Over the past two decades, disruptive events have significantly increased organizations' internal and external risks. Thus, the framework and grouping of the SRES presented in this study provides an excellent managerial guideline to build an appropriate SRES for SResSCM definition.

In summary, the researcher found that there are various SRES practices in the literature. According to contingency theory, it can be concluded that there is not a single best way to manage process, decision-making and leadership because different environments would provide different antecedents (Lawrence and Lorsch, 1967). Thus, contingency theory creates a natural theoretical basis for explaining the circumstances under which SRES evolves. Therefore, as mentioned before in this study, the researcher focused on vulnerabilities and capabilities factors that were studied by Pettit et al. (2010), who provided the first supply chain resilience framework in terms of measureable variables (p.13). Because the researcher found that sub-level of vulnerabilities and capabilities factors are related to environmental, economic, and social dimensions of SSCM. Moreover, Pettit et al.

(2013) also found that external pressure and connectivity from vulnerability factors are the highest important issues for the supply chain and market position, recovery and financial strength are reported as capability strength from their study. Thus, these practices are appropriate SRES practices, which need to be studied more in order to develop SResSCM practices for this thesis. The key consideration is how to embed possible SRES practices into organizations' strategy and supply chains so the researcher needs to fill this gap.

2.5 Performance measurement

Performance measurement is used to measure organizations' ability to support decision-making processes, linking strategy to operations (Taticchi et al., 2013). Numerous organizations have developed and implemented performance in sustainability and resilience in their business, with three main aims: (1) strategy alignment, (2) enhancement of their operations, (3) transparency and communication with stakeholders (Taticchi et al., 2013). Moreover, performance measurement can be defined as "the process of quantifying the efficiency and effectiveness of action" (p.80) (Neely et al., 1995). Hence, the essence of a sustainable and resilient supply chain management approach can only be evaluated by means of reliable performance measures. Taticchi and Balachandran (2008) described performance measurement and management as the process of using measurement information for supporting managers in decision-making processes aiming to link strategy to operations. Hervani et al. (2005) argued that performance measurement must evolve with performance management, where an organization develops the appropriate organizational structure and the ability to use performance measurement results to actually bring about change in the organization.

In addition, Banomyong and Supatn (2011) explained that total supply chain performance can be identified as the efficiency of the whole supply chain of network members, which is very difficult to measure and may not even exist. Effectiveness is the degree to which a customer's requirements are fulfilled, and

efficiency measures how economically an organization's resources are utilized when providing a pre-specified level of customer satisfaction. Performance measurement systems can be explained as the overall series of factors used to quantify both the efficiency and effectiveness of actions. Efficiency is concerned with the economical use of resources, and effectiveness with how well objectives are being met (Taylor, 2004). Cabral et al. (2012) observed that measurement on a continuous basis is crucial to improve operations/processes and supply chains.

- The history of performance measurement in supply chain management

Performance can also be measured by cost, quality, delivery and flexibility (Krause et al., 2007). On the other hand, Otto and Kotzab (2003) categorized performance measurement in SCM into six categories based on certain disciplines: (1) system dynamics; (2) operations research; (3) logistics; (4) marketing; (5) organization; (6) strategy. Closs and Mollenkopf (2004) described the supply chain performance of each organization in terms of five key dimensions of logistics: customer service, cost management, quality, productivity and asset management. In addition, Li et al. (2006) classified organizational performance into short-term and long-term objectives, as short-term objectives of SCM are mostly to improve productivity and decrease inventory and cycle time, whereas long-term objectives are mainly used for increasing market share and profits. From the financial perspective, increasing market share and profits reflects the asset utilization of an organization.

Beamon (1999) gave an overview and assessment of the performance measures used in supply chain models, and also demonstrated a framework of the selection of performance measurement systems in manufacturing supply chains. There are three types of performance measures: resources, output and flexibility. However, there is some lack of system thinking, in which a supply chain should be measured widely across the whole supply chain, rather than relying too heavily on cost as a primary measure.

Gunasekaran et al. (2001) conducted an overview of the various performance metrics across the supply chain, and described sources using these performance

metrics to manage the four basic links of the supply chain, including plan, source, make/assemble and deliver functions. Moreover, Gunasekaran et al. (2004) provided insights into current practices and future requirements in supply chain performance measurement, including issues relevant to green supply chain management, along with issues such as successful implementation, which requires organization-wide coordination. To monitor performance, each metric must have a supply chain perspective; each entity in the supply chain should be measured and improved, with common goals; non-financial metrics should receive more attention than financial ones; and additional and creative efforts are needed to design new measures.

Morgan (2007) provides a useful overview of the historical development of supply chain performance measurement (refer to Figure 2.19). The general trend over time has involved a shift away from the use of purely financial metrics with the importance of the supply network emerging in the final and current phase. This recognizes that customer satisfaction can only come from the supply chain functioning effectively in totality (both processes and process interfaces) (Morgan, 2007). Shaw et al. (2010) discussed that throughout the 1980s and early 1990s, authors suggested various performance frameworks to manage organizational performance: the performance measurement matrix, the performance pyramid, the result-determinants framework, the balanced score-card, the Cambridge Performance Measurement Process and later, the performance prism. This led to the development of a dominant research question in the mid-1990s, particularly for the operations management discipline, of how these performance measurement systems are to be developed and deployed (Neely, 2005). The results of Gimenez et al. (2012) found that supply chain assessment has no impact on the triple bottom line, whereas supply chain collaboration contributes to improve all three pillars.

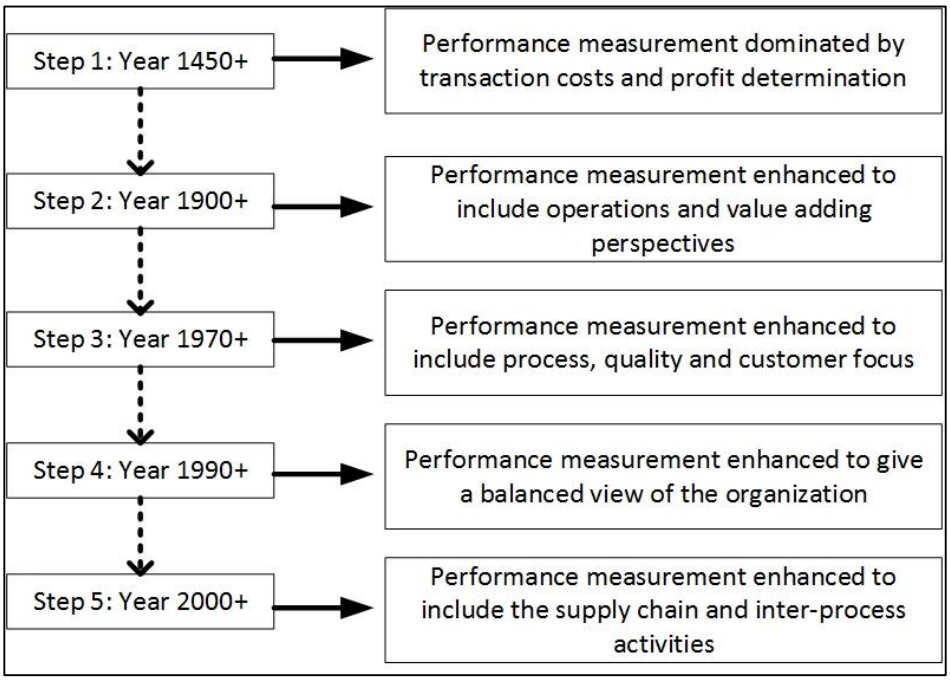

Figure 2.19: Phases of development of supply chain performance measurement *(Source: Morgan (2007))*

Existing literature reviews pay attention to the issues in closed supply chain performance measurement combined with a variety of 1) supply chain performance measurement models or frameworks and 2) performance measurement factors for supply chain performance measurement, also known as performance metrics, key performance indicators (KPIs), or critical success factors (CSFs).

The key challenge of supply chain performance measures for organizations is how to find and develop the possible appropriate performance measures for their supply chain, which difficult to study and identify the measures. For this thesis, performance measurement in SSCM and SRES are explained in the next section.

- Performance measurement in SSCM

There is a clear need to measure environmental performance in order to measure the effects on operations (Shi et al., 2012). James (1994) advised that it requires an extension of the three existing elements of sustainable development – the economic, environmental and social elements, as well as the interactions between them. Taticchi et al. (2013) argued that many organizations are starting to assess

sustainability in their business, with three main goals: (1) transparency and communication with stakeholders, (2) improvement of their operations and (3) strategy alignment. Moreover, some reports have been used to evaluate sustainability metrics, such as Global Reporting Initiative (GRI), which has more than 90 indicators (GRI, 2013b). However, it still needs to link this report with other performance measurements, as reports should introduce performance in relation to the broader concepts of sustainability (GRI, 2013b). Furthermore, the GRI implementation manual highlights that SC topics should be studied within the context of sustainability (GRI, 2013a). Some authors have advised application for ISO certification to assess sustainability in organizations. For example, Hervani et al. (2005) showed the use of ISO 14031 certificate as a tool for performance measurement of green supply chain management. On the other hand, Govindan et al. (2014) found that, while ISO 14001 certification does not have a significant impact on SSCM, It helps organizations to earn more customer satisfaction and to prepare plans for responding to customers' requirements. Customer satisfaction is the performance measure which shows strong dependence and weak driving power, i.e. it is strongly influenced by the other researched variables, but does not affect them (Govindan et al., 2015). Tarjbakhsh and Hassini (2015) classified the indicators into seven dimensions, as economic, environmental, social, valuable, reputable, equitable and sustainable.

It can be seen that there are some performance measurements assessing SSCM. For example, Sheffi and Rice (2005) outlined a plot demonstrating that economic turbulence will have a fluctuating effect on performance measures such as sales, production levels, profits and customer service. Lots of organizations have integrated environmental, social and economic concerns, and assess their supply chain performance by the adoption of SSCM initiatives (Seuring and Müller, 2008b). Moreover, Seuring and Müller (2008b) classified the literature into six categories as: sustainable, environmental, ecological, green, social and ethical. Hassini et al. (2012) studied existing literature reviews published since 1999 in the decision sciences field, and proposed the performance measurement framework of sustainability in supply chains, as well as a practical case study in the energy sector.

Performance measurement of environmental perspective is frequently described by academics. Charmondusit et al. (2014) developed eco-efficiency indicators, which can be used as an environmental tool for measuring wooden toy organizations' status and further trends for the assessment of the wooden toy industry. Moreover, Hajmohammad et al. (2013) demonstrated that an appropriate route to facilitate the implementation and adoption of environmental practices, and to improve a plant's environmental performance is by setting an adequate operating context based on lean and SCM principles. Moreover, Zailani et al. (2012b) described that eco-design mediates the impact of regulation and incentive, and customer pressure on environmental performance. Further, Shaw et al. (2010) developed environmental supply chain performance measures (SCPM), and argued that SCPM can lead organizations to more effectively benchmark their supply chain environmental performance.

Ahi and Searcy (2015) identified and analysed the factors that are mostly used to measure SSCM performance in the literature. It can be seen that there are five factors, which were used more than twenty times in selected literature: air quality, air emissions, greenhouse gas emissions, energy use, and energy consumption, respectively. Moreover, multiple factors were applied to assess similar issues in numerous cases. Bjorklund et al. (2012) reviewed the literature on performance measurement and logistics management, and found that there is a requirement to combine measures across different managerial levels along the supply chain. Moreover, Bjorklund et al. (2012) also argued that researchers have applied current measurement tools from the past, rather than developing a new measurement for supporting future management. In addition, Miemczyk et al. (2012) reviewed the literature on purchasing and SSCM, and found that the social dimension in TBL has received less attention than other dimensions.

In the economic dimension, Gunasekaran et al. (2004) proposed a SCOR-model with four stages: plan, source, make and deliver, and three indicator categories, being strategic, tactical and operational. They found that the strategic measures influence decisions at the highest managerial level. The tactical level deals with measures

against goals to be met and evaluates mid-level decisions. Operational level indicators need accurate data and are related to the decisions of low-level managers.

Studies have been conducted on social dimensions, such as that of Norman and MacDonald (2004) who conducted a study on social concerns, offering a framework of social indicators with five aspects: diversity, unions or industrial relations, health and safety, child labour and community.

Shi et al. (2012) proposed that potential measures of (1) environmental impact reduction would comprise GHG emission reduction; hazardous waste reduction; wastewater discharge reduction; and solid waste disposal reduction, (2) environmental cost saving would consist of green purchasing cost saving; environmental technology investment cost saving; material recovery cost saving; energy cost saving; and environmental risk/penalties cost saving, (3) social issues would comprise of involvement in health and safety committees and health and safety performance measurement systems.

Hassini et al. (2012) proposed the use of composite indicators to create reliable performance measures for SSCM. Composite indicators (CIs) have been used successfully to summarize complex and multi-dimensional indicators. Figure 2.20 shows the proposed framework using Elkington's TBL's principle, each supply chain partner (supplier, manufacturer, distributor, retailer, or customer) collects measures on each of the three dimensions: economic, environment and society. The choice of these measures is to align with each partner's own strategic goals. Partners produce their own internally calculated sub-indicator.

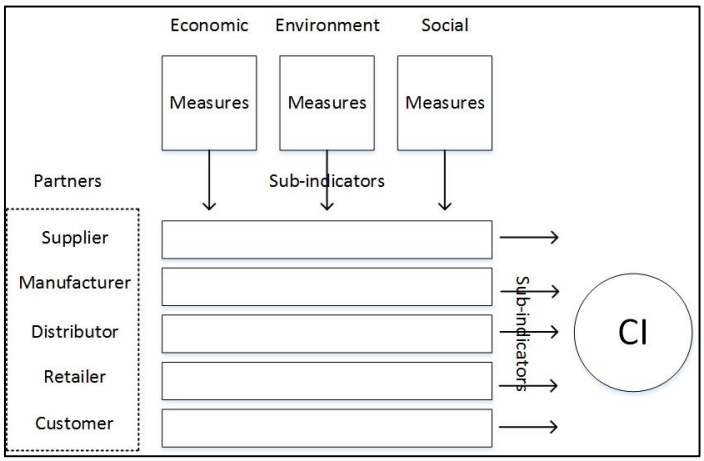

Figure 2.20: Framework for sustainable supply chain metrics *(Source: Hassini et al. (2012))*

Hassini et al. (2012) stated that "different indicators will be needed by different companies and the indicators ultimately selected must reflect the unique needs of the company that will use them" (p.79). Moreover, they also suggested the use of composite indicators. More empirical research is required to validate the proposed framework that will shed light on the indicators companies use to measure the success of their SSCM initiatives. Consequently, it can be seen that there are some SSCM measures, such as air emissions, energy use, energy consumption, health and safety, child labour, emerged in the literature from academics and practitioners. The next section explores performance measurement in SRES field.

- Performance measurement in SRES

Carpenter et al. (2001) argued that it is also important to measure resilience to ensure better resilience outcomes. The resilience capability needed by a system depends on the context and extent of vulnerabilities. Performance measurement in SRES concept is still in its infant phase. As Ponomarov and Holcomb (2009) explained in their research, such measurements will help organizations and their respective supply chains to determine the degree to which parts and factors of SRES should be developed. Furthermore, they also advised that measurement of SRES would suggest a future potential research stream that could contribute important experience or knowledge based on the outcomes of the resilience phenomenon. Most studies have focused on the proactive capabilities, i.e.

flexibility, redundancy, integration and efficiency (Christopher and Peck, 2004a; Pettit et al., 2013) in mitigating supply chain vulnerability and for measuring SRES. In addition, resilience is also measured based on the recovery time after disaster or disruptions, and the time taken to respond (Sheffi and Rice, 2005).

Pettit et al. (2013) developed an SRES measurement tool, that was empirically assessed by seven global manufacturing and service organizations applying qualitative research with 1,369 items. The study findings recommended a positive correlation between increased SRES and operating performance, using supply chain performance measures such as availability, inventories, delivery lead time, order accuracy and customer complaints that needed to be validated in a longitudinal study. Wieland and Wallenburg (2013) found differences between proactive resilience (robustness) and reactive resilience (agility). Their results demonstrate a positive influence of relational competencies, i.e. cooperation and communication between supply chain partners, on SRES that leads to higher supply chain customer value.

Soni et al. (2014) proposed an approach to assess the level of resilience of the supply chain and develop the scope of improvements for better design to handle uncertainties and risk with ten variables to increase the understanding of the supply chain from a resilience point of view. This needs to be developed to enhance overall supply chain risk mitigation capability, and consequently the performance of the supply chain. Nils-Ole et al. (2015) identified that SRES can be quantified through three important performance metrics that enable reporting on how severe a disruption impact is and how an organization's SRES performs as (1) customer service, (2) market share and (3) financial performance.

In conclusion, there are a few measurement can be found in SRES field, such as recovery time after disaster or disruptions, time taken to respond, delivery lead time, order accuracy, and customer complaints. However, it can be seen that performance measurement in SRES field more difficult to measure than SSCM field.

Thus, this is an opportunity to study and develop performance measurement in SRES field that can be adopted within organizations.

- Performance measurement between SSCM and SRES

In recent years, there have been some organizations that have realized the potential of SCM in day-to-day operations management. However, organizations often lack the insight for the development of effective performance measurement factors needed to achieve a fully integrated SCM, due to lack of a balanced approach and lack of clear variance between performance measurement factors in strategic, tactical and operational levels (Gunasekaran et al., 2001). Thus, it is clear that for effective SCM, measurement goals should determine the overall situations and performance measurement factors to be applied. These processes might cover the whole process of supply chains and should be divided into strategic, tactical and operational levels.

Few papers have integrated the measurements for SSCM and SRES. As Foerstl et al. (2010) pointed out, in a dynamic environment, not only might the weight assigned to sustainability indicators have to be adjusted, but also new indicators might have to be added to the assessment scheme. They found that external responsiveness is inalienable for effective sustainability risk management. Murino et al. (2011) studied supply chain performance sustainability through a resilience function with a design of experiments (DOE). They determined the variables having the greatest effects in the supply chain, such as stock level, number of suppliers and production times (speed). They found that production times had a strong effect on the output result, and stock level had a low interaction effect.

Azevedo et al. (2013b) provided “Ecosilient” as a model employed to test supply chain behaviour in terms of the implementation level of green and resilient practices, providing essential information for top-management. It is useful as an essential framework in supporting decision-making regarding green and resilient SCM. Moreover, Govindan et al. (2015) studied supply chain performance by applying lean, green and resilient practices in automotive supply chains in terms of

supply chain performance, i.e. operational cost, business wastage, environmental cost and customer satisfaction. They suggested that just-in-time, flexible transportation and environmentally friendly packaging are the key issues enabling organizations to reach the desired level of customer satisfaction.

Furthermore, regarding to SSCM literature, it identifies varied types of stakeholders that provide pressure for implementing sustainability in organizations (González-Benito and González-Benito, 2006; Zhu et al., 2005), and some of literature review has used stakeholder theory when addressing the issues faced by practitioners when organizations integrated sustainability goals with their operations/productions (Schneider and Wallenburg, 2012). Consequently, in line with stakeholder theory, organizations might implement sustainability concepts after receiving pressure from stakeholders. Accordingly, the two key points that the researcher can conclude from previous studies from literature review are (1) scholars have performance measurement tools in SSCM more than SRES and there is no one measurement scale that assess performance of all dimensions for SSCM and SRES, even though scholars have some studies that integrated these two concepts but it integrated in individual dimension together only, for instance green dimension with SRES, or lean, green and resilient practices; and (2) practitioners normally assess their performance in organizations related to SSCM and SRES; so this thesis combines the performance measurement that can measure for SSCM and SRES to suggest organizations to determine their decision to which parts and factors that need to be improved in the future.

2.6 The relationship between SSCM and SRES

The relationship between SSCM and SRES has been mentioned in the existing literature. There are some discussions on the impact of sustainability on resilience or sustainability risk management (Anderson and Anderson, 2009; Foerstl et al., 2010), and the impact of resilience on sustainability (Murino et al., 2011; Sanchez-Rodrigues et al., 2010). In some cases, the two concepts are interlinked (Govindan et al., 2014; Mari et al., 2014; Thomas et al., 2015).

- Interlinkages between SSCM and SRES

Fiksel (2003) suggested a draft for designing sustainable resilient systems. His study adapted the systems perspective and demonstrated that resilience and sustainability are interlinked, as the resilience perspectives impact organizations to become more sustainable. Moreover, they suggested that organizations, which wish to ensure their long-term resilience must reach beyond their own boundaries, develop an understanding of the intricate systems in which they participate, and strive for continuous innovation and renewal. However, in this field, strategic adaption becomes more important than strategic planning, and decision-makers need to embrace uncertainty, rather than trying to eliminate it. As Hamel and Valikangas (2004) stated, "any organization that can make sense of its environment, generate strategic options, and re-align its resources faster than its rivals will enjoy a decisive advantage. This is the essence of resilience" (p.357).

Fiksel (2006) argued that the combination of enterprise sustainability and resilience creates multiple business opportunities through green technologies, reduction of raw material and energy use, and discovering innovative pathways for recovery and re-use of waste streams in places of virgin resources.

Carter and Rogers (2008) proposed that risk management, which consists of contingency plan and supply disruptions, is a critical issue that should be examined together with environmental performance to achieve sustainability. Anderson and Anderson (2009) studied sustainability risk fields and commented on six areas of sustainability risk, i.e. global warming/climate change, boycotts, environmental liability ecosystems, social responsibility, and directors' and officers' liability. They found some relationships between sustainability and risk management. According to Hofmann et al. (2014), some published papers have highlighted that scholars have begun to combine the sustainability concept with supply chain risk management research. However, there is neither a well-grounded conceptualization of sustainability risks, nor suitable prescriptions for their specific management. In addition, Hofmann et al. (2014) made two major contributions in their study, which 1) further integrates the sustainability concept and stakeholder

theory into general supply chain risk management; and 2) offers a concept for organizations to govern their supply chain sustainability risks, which can be conjectured to increase levels of sustainability along supply chains. The results suggest that supply chain risk management should not only focus on disruptive events, but also on possible stakeholder reactions.

More recently, Ahi and Searcy (2013) expanded business sustainability characteristics to an integrated perspective, including not only the environmental, social and economic focus, but also along the lines of stakeholders, volunteers, resilience, flow, coordination and long-term performance. However, they concluded that resilience is rarely addressed in definitions of business sustainability.

Fiksel et al. (2014) studied a variety of approaches for strengthening both resilience and sustainability in urban communities and industrial enterprises. The goal of this study is to understand the dynamic relationships between human and natural systems that will help planners to develop more resilient strategies, which will reduce vulnerability to unforeseen disruptions, enable continued growth and prosperity, and respect ecological resource capacity. They stated that there may be trade-offs between sustainability and resilience (Figure 2.21), and that energy, water and manufacturing represent sustainability and resilience (smart grid, grey water use), or are neither sustainable nor resilient (corn ethanol, bottled water), neither sustainable nor resilient (nuclear energy, rain harvesting), or neither resilient nor sustainable (diesel back up, desalination).

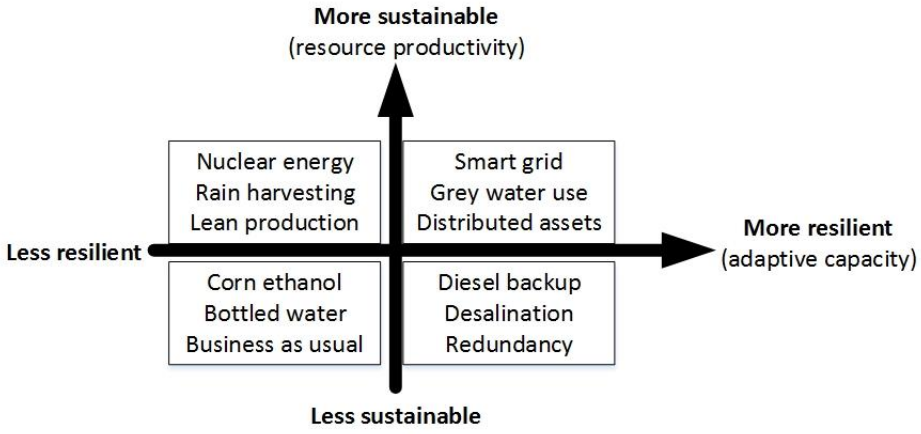

Figure 2.21: Examples of synergies and trade-offs between sustainability and resiliency *(Source: Fiksel et al. (2014))*

Mari et al. (2014) introduced a network optimization model for a sustainable and resilient supply chain network, believing that the new challenge for supply chain managers is to design an efficient and effective supply chain network that will be resilient enough to bounce back from any disruption, and which should also have sufficient vigilance to offer the same sustainability under a state of disruption. The results highlight a resilience factor in the design of the sustainable supply chain network by incorporating location-based risks, because it was observed in practice that maintaining sustainability in a supply chain network is difficult during disruptions, such as natural or man-made disasters.

Mollenkopf et al. (2010), who examined the relationship among green, lean and global supply chain strategies, found that "although green, lean and global supply chain strategies each focus on cost-reduction capabilities, green strategies also capitalize on the potential profitability from gaining new customer market segments" (p.28). Furthermore, Garza-Reyes (2015) stated that some authors considered that not only the trade-offs between lean and green, but also other paradigms, such as agility and resilience may help operations/processes and supply chains to become more efficient, streamlined and sustainable.

Reham (2016) explored the necessary role of supply management resilience capabilities in making effective trade-offs to attain an ambidextrous state, and

developed an explanatory and normative framework of supply chain capabilities that translate into a resilience paradigm which produces effective exploitative and explorative sustainability trade-offs. They explored the notion of trade-offs in managing the tensions between exploitative and explorative supply chain performance goals, i.e. attained supply chain ambidexterity.

- The impact of SSCM on SRES

There are studies about the impacts of SSCM on SRES. Sheffi and Rice (2005) argued that an organization's ability to survive after a disruption assures operational sustainability. This is an impact of sustainability on resilience in the supply chain. Strategic initiatives addressing building resilience will change the way in which organizations operate, enhancing their competitiveness in the market.

Foerstl et al. (2010) believed that organizations which outsource production to suppliers cannot transfer the risk related to unacceptable environmental and social standards at suppliers' premises, but must seek active management of the supply base for sustainability. They mentioned that purchasing and supply management plays an important role in the mitigation of sustainability risks. Moreover, Foerstl et al. (2010) suggested that organizations and their purchasing and supply management should take a step forward and implement a structured sustainability risk assessment and subsequent supplier selection and development to effectively manage a sustainable portfolio of suppliers.

Furthermore, Park et al. (2010) suggested that organizations and SRES can gain through environmental management practices. For example, having the suitable technology and organizational capacity to re-use and recycle waste streams can greatly improve the availability of materials, as well as sustaining the supply channels. In addition, supply chain risks can result from poor environmental and social performance by organizations and their suppliers, which can have a costly legal effect (Soni et al., 2011). Pettit et al. (2013) stated that SRES draws from the foundations of many disciplines, encompassing ecology, psychology, sociology, risk management and network theory, and also impacts on global economies. This point

shows that SRES is related to sustainability, although the relationship of these two themes is not provided.

Johnson et al. (2013) explored the relationship between three dimensions of social capital (as cognitive, structural and relational) and the four formative capabilities of SRES (as flexibility, velocity, visibility and collaboration). The results explain that the dimensions of social capital play an influential role in facilitating the four formative capabilities for SRES and indicate the potential for these to be mutually reinforcing.

Beske and Seuring (2014) identified key categories of SSCM, which are of high importance for the sustainable management of supply chains as: orientation toward SCM and sustainability, continuity, collaboration, risk management and proactivity. They found that enhanced communication and technological integration have to extend further for SSCM and the related debate on sustainable products (Seuring, 2011). To reduce risks and uncertainty, enhanced communication (or collaboration) is thus a useful practice, especially when evaluating whether the ingredients and working conditions are acceptable. Moreover, they found that organizations can reduce the supplier base and hence the risks associated with individual supplies, though at the cost of higher dependability on fewer suppliers in long-term relationships.

- The impact of SRES on SSCM

Some academics have discussed the impact of SRES on SSCM. For instance, It is an interesting point that organizations are looking to provide strategies with newly appearing principles, such as SCRM and SSCM, because SRES is the key to progressing an appropriate strategic plan that is sustainable and effective in producing better results than smaller resilient competitors (Stoltz, 2004). Carter and Rogers (2008) proposed that SCRM, including uncertainty planning and supply disruptions, are critical elements that should be examined together with environmental performance in order to accomplish SSCM.

Spekman and Davis (2004) studied supply chain-related risks and mentioned that several factors drive organizations to accept responsibility for managing partner CSRs, including customer and stakeholder expectations and the potential legal liability. Moreover, CSR issues within the supply chains also create legal and public policy problems for organizations. In addition, they explained that organizations must be prepared to control the parallel risks that reflect the consequence of their partners' policies and actions on ethical and environmental issues.

According to Ponomarov and Holcomb (2009), the implications for SCM and SRES relationships and the methodologies for controlling key issues are still in early development. In addition, they collated various definitions of SRES and formulated a framework exhibiting how SRES can direct sustainable competitive advantage through the integration of various logistics capabilities, as resilience enforces a key character in sustaining dynamic capabilities and maintaining the connection between dynamically integrated capabilities (Ponomarov and Holcomb, 2009). The concept of resilience is directly related to important issues such as ecological and social vulnerability, the politics and psychology of disaster recovery, and risk management under increasing threats (Ponomarov and Holcomb, 2009).

Harwood et al. (2011) conducted surveys related to the resilience of CSR activities in UK organizations. The results show that organizations have been involved in a wide range of CSR activities. They found that the most frequently socially responsible activities were staff welfare, and charity and local community work, the reason (by quite some margin) being "it's just the right thing to do" (p.289).

Lemke and Petersen (2013) analysed reputation, the associated risks and social responsibility as mitigating risk strategy on conceptual grounds. They found that the removal or mitigation of risk could be accomplished through the implementation of supply chain social responsibility (SCSR). Collaborating with suitable partners can only be done when the set of supplier selection factors is updated with social responsibility measures.

The link between sustainability and resilience has been investigated by academics such as Govindan et al. (2014), who found that lean, resilient and green SCM practices, including waste elimination, supply chain risk management and cleaner production impact on SC sustainability. These three SCM practices have significant impact on social, economic and environmental sustainability of supply chains.

This is related to the studies of Azevedo et al. (2012) and Azevedo et al. (2013b), who found that green and lean practices are two important pillars of sustainable development in business. Further, green practices and SRES are ways to increase the sustainability of organizations and their supply chains. However, it may be concluded that the relation between SSCM and SRES is still unclear and remains uninvestigated. Thus, this study aims to fill this gap in the literature.

The relationship between SSCM and SRES in the existing literature is presented in Table 2.7.

Table 2.7: The relationship between SSCM and SRES in literature

Author(s)	Details	Relationship path
Spekman and Davis (2004)	Highlight six areas of supply chain-related risks	Risk → CSR
Park (2008)	Manage the corporate environmental and social responsibility concerns by climate change	Environment and social → the climate change issues
Anderson and Anderson (2009)	Sustainability risk management is concerned with environmental and social responsibility risks	Environment and social → risk management
Foerstl et al. (2010)	The integration of sustainability risk management in supplier management processes.	Environment and social → risk management
Fu and Rutherford (2010)	Developed cultural dimension to the supply chain risk management	Social → SCRM
Oglethorpe and Heron (2010)	To promote conventional supply chain management to achieve climate change targets	TBL → Climate change
Harwood et al. (2011)	Study the relationship between resilience and CSR activities	Resilience on → CSR activities
Hofmann (2011)	Highlight the potentials of natural hedging as a risk prophylaxis and a supplier financing approach	RM → Economic
Murino et al. (2011)	Sustainability through resilience function	Resilience function → TBL
Sanchez-Rodrigues et al. (2010)	Investigate supply chain uncertainty to sustainability	Supply chain uncertainty → economic and environmental sustainability
Azevedo et al. (2013)	Integrate environment and resilient dimension together	Combine green practices and resilience
Johnson et al. (2013)	Study in social capital with the formative capabilities for SRES	Social → SRES
Lemke and Petersen (2013)	Study supply chain risk management with CSR	SCRM → CSR
Beske and Seuring (2014)	Identify key categories of SSCM and related practices	SSCM → collaboration and RM
Govindan et al. (2014)	Identify the critical lean, green and resilient practices to improve the performance of automotive supply chain.	Combine lean, green, and resilience practices together
Hofmann et al. (2014)	Integrate sustainability concepts into risk management	TBL → risk management
Mari et al. (2014)	Consider the resilience and sustainability of the supply chain network	Combine sustainability and resilience in SC
Thomas et al. (2014)	Create resilient and sustainable manufacturing business	Integrate sustainability and resilience in manufacturing business

In summary, the researcher discussed the insights arising from the literature review in order to identify the overlapping areas between the two different bodies of knowledge. However, there is no one study about the combination between SSCM and SRES in term of practices, which can promote or improve both concepts, i.e. sustainability and resilience, at the same time. The key consideration from this section is how to integrate SSCM and SRES in terms of definition and practices into one concept that all organizations around the world can use and apply in their supply chain. This suggests that it is necessary to study and develop SResSCM in manufacturing because there is a limited number of contributions have focused on both concepts, i.e. SSCM and SRES, in the manufacturing in the past. Furthermore, there is a main key point that the researcher can summarize from research by these authors, as there are some researches that combined SSCM and SRES together but in some dimensions only so it can be highlighted that there is the relationship between SSCM and SRES emerged from the existing literature. Thus, this is a good opportunity to develop SResSCM concept that integrate SSCM and SRES into one concept and to provide SResSCM practices, which developing countries from East nation can adopt as a standard level to improve their performance in supply chain and organization level.

2.7 Supply chain management in Thailand and the electrical, electronic and automotive industry

As mentioned in Section 1.2, Thailand was selected as research context for this thesis. Therefore, this section presents the background of Thailand, the studies of SCM, SSCM and SRES in Thailand, then Thai's electrical, electronic and automotive industry are explained at the last section. As Thailand has the second largest economy in Southeast Asia, with a population of around 68 million people. The economic structures in Thailand can be separated into three main structures, being industry, services and agriculture, with percentages in 2012 being 45%, 43% and 12%, respectively (Dejneeranat, 2013). Furthermore, in 2011, the electrical and electronic industry provided nearly 24% (around US$55 billion) of Thailand's annual export revenue. The main export destinations are ASEAN, Europe, China, USA, Hong

Kong, and Japan (BOI, 2013). Moreover, in 2012 Thailand exported from various sectors, such as manufacturing, agricultural, agro industry, mining and fuel and others, being 73%, 13%, 8%, 5.8% and 0.2%, respectively (BOI, 2012).

As explained in the Manufacturing Logistics Development Master Plan for 2012 – 2016 (Paijitprapapon, 2013), there were two main goals for the end of 2016: (1) to reduce industrial logistics cost/GDP by around 15% and (2) to improve 10% of efficiency for industrial logistics performance in three main aspects, i.e. cost, time and quality. Therefore, the Government of Thailand provided strategic agendas for this plan (Paijitprapapon, 2013) as follows:

1) Develop business professionalism in logistics management for industry.
2) Institute combination of supply chains with collaboration and connectivity working together.
3) Encourage the national supply chain to have more competitive advantages by providing important support.

The Ministry of Industry is the primary agency in Thailand, which has set strategies for industrial development. To promote the growth and development of industries, the Ministry of Industry has launched a Green Industry Project. Organizations which enroll in this project will be certified and evaluated on the green considerations in their organizations (Kamolkittiwong and Phruksaphanrat, 2015). During the procedure, industries will have a good image of credibility and public trust. Furthermore, the creation of a green economy will result in higher gross domestic product (Project, 2014). The green industry levels are categorized into five levels as follows (Project, 2014):

1) Green Commitment: “Commitment demonstrated by policy, goals and action plans to reduce environmental impacts, and effective organizational internal communication”.

2) Green Activity: “Activities in compliance with policy, goals and plans, which have been set to reduce substantially environmental impacts as commitment states”.
3) Green System: “Systematic environmental management including follow-up, assessment and revision aimed at continuous development as well as receiving a widely recognized award on environment and accreditations on a variety of environments”.
4) Green Culture: “Cooperation of employees in all levels of an organization to implement a friendly environment in all aspects of business operation until it becomes a part of organizational culture”.
5) Green Network: “Demonstration of network extension throughout green demand chains by promotion business partners and allies entering into accredited green industry process”.

Since this study has collected data from the electrical and electronic industry and automotive industry in Thailand, there is a need to understand the current situation of SCM, SSCM and SRES research in Thailand. Therefore, this section presents a systematic review of the published papers that have been conducted in Thailand or are based on the context of Thailand. Thus, this study can make a clear contribution to SResSCM research in Thailand.

- Study of SCM, SSCM, SRES in Thailand

Due to SCM being one of the strategies, which influence the Thai economy, some researchers have studied SCM in Thailand during the last decade. For example, Banomyong et al. (2007) performed a case study on electrical appliance manufacturers in Thailand with reverse logistics. The results suggested that reverse logistics helps to reduce cost and improve customer satisfaction. In addition, Chawalil et al. (2013) investigated possible factors via a questionnaire survey to help electronics and automotive manufacturers in Thailand to implement supply chain collaborations in their organizations. They also studied the relationship between supply chain collaborations and supply chain performance. The findings explained that machinery industries in Thailand have been applying SCM practices

and investing assets, tangible and intangible, into gaining more benefit from supply chain collaborations. Furthermore, they argued that suppliers in developing countries will be able to learn by producing goods in an international supply chain, so that it will be worth making the investments necessary in educating potentially capable suppliers to enter into a global supply chain at any cost.

There have been some studies on supply chain performance measurement in Thailand. For example, Yaibuathet et al. (2008) studied the development of SCM in Japan, China and Thailand, and the results showed that environment plays as an important role in performance level and will be the main factor in improving supply chain performance in organizations. In addition, they found that the organizations in developing countries, such as Thailand, believe that a higher degree of IT utilization will result in better SCM performance. Similarly, organizations in developed countries focus on developing operational systems for supply chains.

Moreover, Banomyong and Supatn (2011) studied a supply chain performance assessment tool, used to measure the performance of key supply chain activities for SME in Thailand. The findings illustrated that logistics cost data are difficult to calculate because traditional accounting practices are usually unable to identify and distinguish specific supply chain activity cost, and most SMEs did not have enough knowledge about their supply chain activity costs. Moreover, they mentioned that only a few studies have quantitatively investigated SCM and related practices in South East Asian countries such as Thailand.

There are some studies relating to SSCM in Thailand. Rao (2002) studied the concept of greening in supply chains among screening suppliers for their environmental performance, collecting data in South East Asia. The findings showed that supply chain environmental management (SCEM) had started being taken into account in these countries already, at least among the leading edge ISO 14001 certified organizations. Furthermore, the results suggested that greening of suppliers would significantly enhance organizations' environmental performance, leading to competitiveness and enhancing economic performance. Rao believed

that greening of suppliers is really needed in this region because of the large scale manufacturing activities, which are mainly handled by suppliers of the larger organizations. In addition, Gallagher et al. (2004) studied the difference between environmental management in the USA and Thailand, using four case studies, and found that the one possible national difference was that Thai organizations' top EMS priorities were regulatory compliance issues, whereas US organizations were more focused on eco-efficiency priorities. Moreover, they highlighted eco-efficiency improvements, employee awareness benefits and community goodwill as primary benefits of EMS adoption.

Besides, Thanyaphat et al. (2014) identified the conceptual framework of performance for sustainable supply chain management (P-SSCM) in the Thai Cement industry. The result showed the environmental and social problems emerging from an industrial sector, most organizations focusing on developing SCM to support other economic sectors. In addition, there has been some research published in Thailand on the environmental dimension. For instance, Kamolkittiwong and Phruksaphanrat (2015) argued that the main key drivers affecting the implementation of green supply chain management in Thai's electronic industry are regulation, support from top management and the market/consumer, and organizational strategy. Moreover, Banomyong et al. (2007), explained that leagile paradigm supports reverse logistics in manufacturing to increase customer satisfaction by reducing lead time for product repair. Mungkung et al. (2012) studied Thai's chicken and tuna supply chain for carbon footprints and found that broiler farms and tuna fisheries are key contributors to the total carbon footprint of the two products considered.

Moreover, Charmondusit et al. (2014) presented the development of eco-friendly indicators for quantitative measurement of the wooden toy industry in Thailand. They applied eco-friendly indicators in the wooden toy industry with three axes of sustainable development: 1) economic indicator, i.e. net sale and gross margin; 2) environmental indicator, i.e. material, energy, water consumption, and waste disposal; 3) social indicator, i.e. frequency rate of accidents, local employment and

corporate social responsibility. They found that eco-efficiency evaluation in the supply chain could ensure that there would be sustainable and environmentally conscious manufacturing.

In addition, Limoubpratum et al. (2015) investigated how cooperative and competition strategy can lead to the achieving of sustainability, and found that managers strongly believe in competitive approach by improving economic, social and environmental aspects to reach sustainable logistics distribution. These results help managers to understand that organizations perceived to collaborate with competitors in a horizontal relationship can achieve sustainable logistics distribution. Furthermore, Teppraśit and Yuvanont (2015) studied logistics management in reverse logistics for its direct and indirect effects in Thailand's electronics industry, and found that not all elements of logistics management have an impact on the outcome of reverse logistics, but that there were five elements that impact on this study: 1) product design and choice of materials, 2) transportation and movement, 3) manufacturing, 4) packaging and 5) communication. They believed that the finding will help supply chain and logistics managers of electronic companies to have better understanding in specifying the improvement of reverse logistics management within their supply chains.

Ying Kei et al. (2016) tested the model of supply disruption risk and uncertainty using the data collected from the Thai beverage industry, and concluded that demand uncertainty and quality uncertainty affect the risk perception of purchasing managers, and are related to the magnitude of disruption risk, rather than the frequency of occurrence. The finding also explained that quality uncertainty negatively impacts on the severity of disruption risk. They believed that managers will receive the right direction on how to formulate and target their disruption risk management strategies.

The research on SCM, SSCM and SRES in Thailand is summarized in Table 2.8. Thirteen papers were collected from the SLR process in the database. However, these numbers are low when compared with other contexts, as research in Thailand

is not often published in academic journals, and is rarely written in English. Moreover, SResSCM has only just emerged as a new theme in the SCM context, and also in Thailand.

Table 2.8: SCM research in Thailand

Author(s)	Detail	Sector(s)
Rao (2002)	He developed supply chain environmental management model and tested in South East Asia	Philippines, Indonesia, Malaysia, Thailand and Singapore
Gallagher et al. (2004)	They compared the environmental management system implementation experience between two countries with four companies	The United States and Thailand
Banomyong et al. (2007)	They presented and studied leagile concept in the reverse logistics	An electrical manufacturing firm in Thailand
Yaibuathet et al. (2008)	They investigated by focusing on supply chain operational performance between the three countries	Japan, Thailand, and China
Banomyong and Supatn (2011)	They showed a supply chain performance assessment tool of key supply chain activities	Thailand's SMEs
Mungkung et al. (2012)	They studied carbon footprint and provided carbon footprint reduction procedures along the whole supply chain	Thailand's Food industry (chicken and tuna)
Chawalil et al. (2013)	They examined factors that encourage firms to enter into supply chain collaborations and relationships between SCCs and supply chain performance	Thailand's automotive and electronics industries
Charmondusit et al. (2014)	They developed eco-friendly indicators for quantitative measurement within the supply chains	Thailand's wooden toy industry
Thanyaphat et al. (2014)	They explored P-SSCM conceptual framework with content analysis	Thai Cement industry
Kamolkittiwong and Phruksaphanrat (2015)	They identified factors that are critical for the implementation of the GSCM strategy	Thailand's Electronic industry
Limoubpratum et al. (2015)	They developed a hypothesized model to examine the effect of cooperation among competitors (COOP) strategies on sustainable distribution	Medium and large firms identified from Thailand's Newspaper industry
Tepprasit and Yuvanont (2015)	They studied the direct and indirect effects of logistics management on the effectiveness of reverse logistics	Thailand's electronics industry
Ying Kei et al. (2016)	They developed and tested the model of supply chain disruption risk and uncertainty	Thai beverage industry

Based on the information from The Thai Chamber of Commerce, as presented in Figure 2.22, it can be seen that Thailand exports manufacturing products more than

70% of all their export products in the last 25 years. Moreover, Table 2.9 presents top 15 export products from Thailand to Worldwide between 2015 – 2017. Automotive industry as motorcars, parts and accessories, are exported about 12% of all products. While electrical and electronic industry as machines and parts, integrated circuits and air-conditioning and parts also are important export products for Thailand.

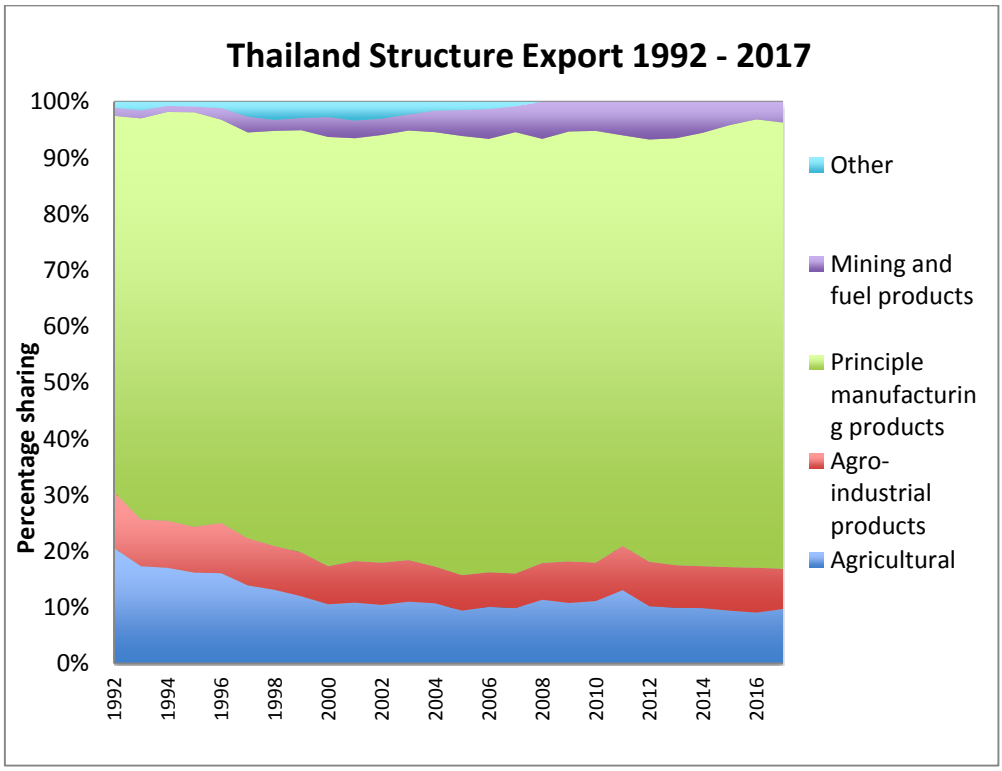

Figure 2.22: Thailand structure export for all industry *(Source: Information and communication technology center with cooperation of the customs department,(www.tradereport.moc.go.th))*

Table 2.9: Thailand export by top 15 products *(Source: Information and communication technology center with cooperation of the customs department, www.tradereport.moc.go.th)*

Product	Export Share (%)		
	2015	2016	2017
Motor cars, parts and accessories	11.95	12.23	11.42
Automatic data processing machines and parts	8.24	7.78	7.81
Precious stones and jewellery	5.14	6.64	5.44
Rubber products	3.19	3.05	4.33
Polymers of ethylene, propylene, etc in primary	3.85	3.58	3.66
Electronic integrated circuits	3.62	3.58	3.49
Machinery and parts thereof	3.30	3.23	3.20
Chemical products	2.98	2.83	3.10
Refine fuels	3.76	2.56	3.03
Rubber	2.36	2.06	2.56
Iron and steel and their products	2.48	2.41	2.37
Rice	2.16	2.05	2.18
Air conditioning machine and parts thereof	2.13	2.26	2.05
Spark-ignition reciprocating internal combustion	1.48	1.70	1.83
Plastic products	1.68	1.73	1.71

Furthermore, Table 2.10 also shows top 15 destinations from Thailand. Most of products from Thailand were distributed to China and USA, and also export around South East Asia and Europe. The insights arising from these tables, it can be concluded that Thailand is an important manufacturing to supply materials for Worldwide.

Table 2.10: Thailand export by top 15 countries *(Source: Information and communication technology center with cooperation of the customs department, www.tradereport.moc.go.th)*

Country	Share (%)		
	2015	2016	2017
CHINA	11.08	11.04	12.43
U.S.A.	11.23	11.37	11.21
JAPAN	9.35	9.51	9.43
HONG KONG	5.53	5.33	5.20
VIETNAM	4.17	4.37	4.92
AUSTRALIA	4.56	4.79	4.44
MALAYSIA	4.74	4.47	4.37
INDONESIA	3.65	3.80	3.72
SINGAPORE	4.07	3.82	3.51
PHILIPPINES	2.81	2.97	2.93
INDIA	2.46	2.39	2.74
CAMBODIA	2.31	2.17	2.23
GERMANY	2.00	2.08	2.08
NETHERLANDS	1.99	1.96	2.02
S. KOREA	1.91	1.89	1.98

Moreover, regarding to the World Risk Report for 2014 and 2016, the report provided that Thailand has World Risk Index (WRI), which is the risk of becoming the victim of a disaster resulting from an extreme natural event for every country worldwide, at ranking 89 from 171 countries with 6.38% in 2014 and 6.19% in 2016. The average WRI for Thailand between 2012 –2016 is 6.35% as presented in Figure 2.23. For this index, risk comprises exposure to natural hazards and the vulnerability of a society so it highlights that Thailand is in middle risk in the World. In this sense, SRES concept is a key support for Thai manufacturing to overcome any disruption in the past and future. Moreover, it is an opportunity for the researcher to study and understand how Thai manufacturing develops SRES in organizations.

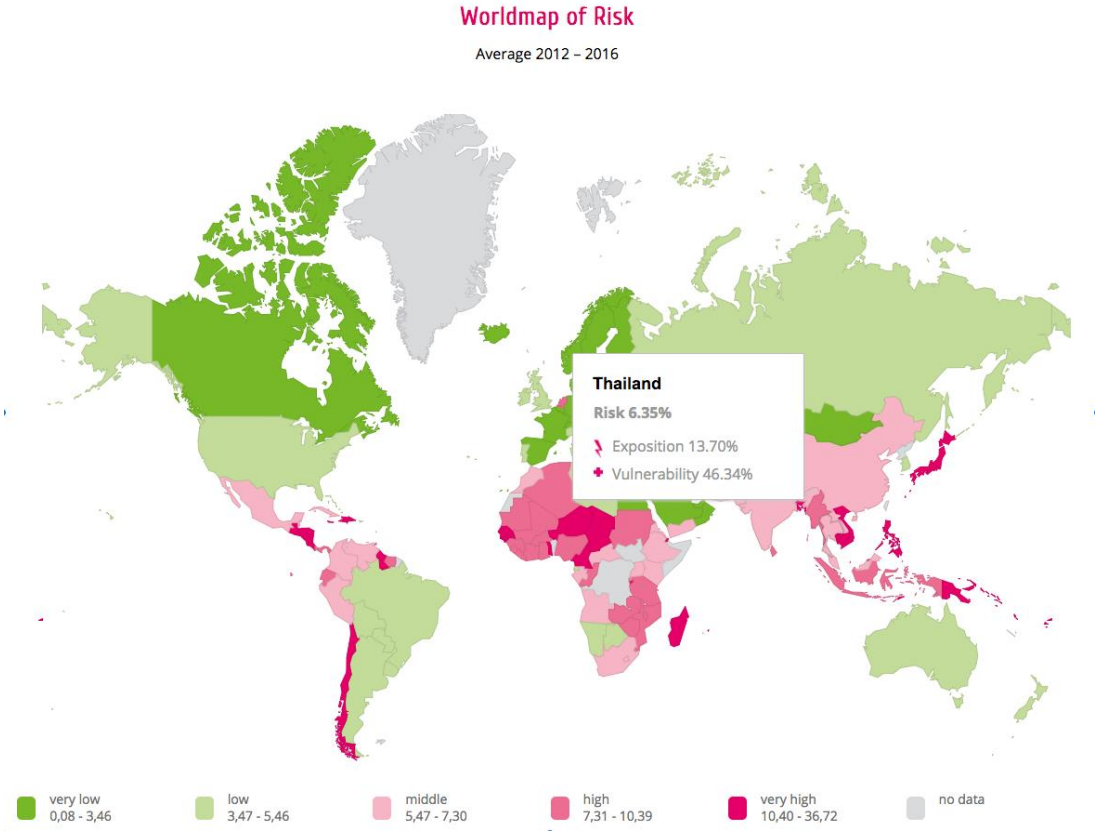

Figure 2.23: World of Risk (Source: http://weltrisikobericht.de/)

In order to better understand Thai manufacturing as the research context, it is also important to study the background for each industry in Thailand. The next section presents about Thai manufacturing as specific sectors in this thesis, i.e. (1) electrical and electronic industry and (2) automotive industry.

- Electrical and Electronic industry in Thailand

The electrical and electronic industry plays an important role in the nation's economy as a major export earner, and also supports Thailand as the regional leader in South East Asia (BOI, 2013). Having had a total export value of about $55 billion in 2011 and 2014, Thailand's electrical and electronics industry has flourished and developed for decades (BOI, 2015b). Moreover, Thailand's Government Investment policies have attracted multinational companies to invest in Thailand, and newcomers to start up businesses in the industry, adding to prosperity in Thailand (BOI, 2013, 2015b).

In 2011 and 2014, the electrical and electronic industry provided approximately 24% of Thailand's annual export revenues, major export destinations being the USA (13 – 17.3%), ASEAN (16.7 – 17%), the EU (14%), China (8.8 – 14%), Hong Kong (12.5%), and Japan (10%) (BOI, 2013, 2015b). Almost 800 electrical appliance factories and about 700 electronic organizations cross-country have attracted numerous world-renowned foreign and joint venture companies from around the world. The organizations who have business plans in Thailand include: from Japan, Pioneer, Sony, Sharp, Hitachi, Nikon, Canon, Epson and Fujitsu; from Taiwan, Acer; from South Korea, Samsung and LG; from USA, Western Digital, Hutchison, Seagate, Spansion; and from Europe, Electrolux, Philips and Schneider (BOI, 2013).

Based on the export quantities in 2011 and 2014, Thailand provided major electrical appliance products in three main areas: (1) air conditioners - about 15% (in 2011) – 17% (in 2014); (2) refrigerators - nearly 6% of total electrical appliance exports in 2014; (3) digital cameras and video camera recorders - with decreased export value from 2011 to 2014 (BOI, 2013, 2015b). Thailand also supplied main electronics exports such as hard disk drives (HDD) and integrated circuits (IC), which accounted for about 34% and 26% in 2011, and computer components and integrated circuits (IC), which accounted for about 56% and 24% respectively of total electronics exports (BOI, 2013, 2015b).

As the report from BOI (2013) shows, Thailand contributed approximately 32% of hard disk drive parts from Western Digital (WD) and Seagate, making it the 2nd largest exporter of electronic products in 2014.. Furthermore, the country has over 600,000 people employed in its electrical and electronics sector. Foreign investors are often drawn to Thailand due to the cost effective and highly skilled workforce (BOI, 2015b). More than 60 public and private engineering institutes across the country are accredited by the Council of Engineers (BOI, 2013).

Kamolkittiwong and Phruksaphanrat (2015) suggested that green product innovation should be adopted to meet market demand and gain competitive advantage. Furthermore, organizational strategy is also one of the crucial factors needed to support the implementation of GSCM. Economic benefit, competitors, cost reduction, social/stakeholder, reverse logistics and supplier are lower levels of important criteria influencing the implementation of GSCM in the electronic industry in Thailand (Kamolkittiwong and Phruksaphanrat, 2015). Moreover, Zhang et al. (2009) found a positive association between buyer communication and suppliers' willingness to invest in technology. The findings of Kamolkittiwong and Phruksaphanrat (2015) study indicated that automotive and electronics industries in Thailand have invested in tangible and intangible assets to achieve effective exchanges of information and realize the potential benefits from costly information exchanges.

- Automotive industry in Thailand

Thailand's automotive industry contributed about 12% of Thailand's gross domestic product (GDP) in 2013. There are over 550,000 employees in this industry, producing approximately 2.85 million vehicles. Moreover, Thailand supports the automotive industry by promoting and developing global green automotive production related to the Master Plan for Automotive Industry (2012 – 2016) (BOI, 2015a).

Thai Automotive Industry encompasses large-scale enterprises (assemblers and Tier 1 suppliers) and small and medium-sized enterprises (Tiers 1, 2 and 3 suppliers).

Some major multinational automotive organizations are located in Thailand, i.e. Mercedes-Benz Thailand, Ford and Mazda (Auto Alliance Thailand), BMW Manufacturing, General Motors, Honda Automobile, Hino Motor, Isuzu Motors, Mitsubishi Motors, Nissan Motors, Tata Motors, Toyota Motors, Suzuki Motor, and Volvo Car Thailand (BOI, 2015a).

In addition, the automotive industry represented a major part of Thailand's economy in 2014, being the country's largest export sector, with exports amounting to approximately US$30 billion. Moreover, Thailand is a superb location for automotive production, due to its strategic location at the centre of South East Asia. It is the strongest industry in the region, with excellent infrastructure and strong government support (BOI, 2015a). In 2013, Thailand was ranked 9th in the supplied automotive industry, manufacturing around 2.46 million vehicles. It supplies major automotive products to Australia and Indonesia among others, the top ten destinations for Thai automotive exports accounting for 57% (BOI, 2015a).

Thailand's automotive industry consists of two main critical sectors, being automotive parts and components, with about 2,400 automotive suppliers in Thailand, and 709 original equipment manufacturers (OEMs). There are also some foreign parts and components manufacturers in Thailand, i.e. Bosch, Denso, Continental, Magna international, Aisin Seiki, Johnson Controls, Faurecia, ZF Friedrichshafen, Yazaki and Lear (BOI, 2015a). According to a report from Japan Automotive Manufacturers Association, Thai-made automotive parts are of a high quality when compared with those of other countries. Furthermore, 85% of locally manufactured parts were supplied for pickup truck assembly, and 70% were supplied for passenger cars, which were assembled in Thailand (BOI, 2015a).

Most of the world's major car-makers, assemblers, parts and components manufacturers have a manufacturing presence in Thailand. All of the leading Japanese automotive manufacturers have opened production sites in the country, as have major western automotive firms, such as BMW, Daimler, Ford Motors and General Motors (BOI, 2015a).

In summary, it can be seen that Thailand is a developing country from South-East Asia, where deliver products to East countries, so organizations in Thailand might applied some practices or procedures related to their customers. Moreover, electrical, electronic and automotive industry in Thailand are a key industry for Thai Economics, therefore, this thesis will support Thai Government, policy maker in organizations and interesting person, who would like to adapt or apply SResSCM concept to improve sustainability and resilience in their organization and supply chain at the same time. Developing nation needs to improve their performance and attract developed nation to buy or invest in their country. Thus, Thailand will provide insight information for SResSCM as a main concept for this thesis.

2.8 Research gaps and SResSCM framework

Based on papers in the existing literature, some research gaps can be seen in the SSCM field (Section 2.4.2), SRES field (Section 2.4.3), and performance measurement (2.5), the relationship between SSCM and SRES (Section 2.6) and supply chain management in Thailand (Section 2.7). These gaps are explained below.

As discussed before, Winter and Knemeyer (2013) revealed that most papers in the literature have focused on individual dimensions of SSCM, rather than the combination dimensions. The results also suggest that future research should expand measurement scales to estimate the impact of SSCM or the combination between risk management and sustainability related to SCM. Furthermore, Pettit et al. (2013) suggested that “future research may determine multiple measures at each sub-factor level, with the addition of objective measurement where appropriate” (p.57). In addition, Hassini et al. (2012) suggested the use of composite indicators with existing performance management theory, which has several principals for implementation in a supply chain.

Soni et al. (2011) argue further research should also integrate an organization’s approach to before and after unforeseen disruptions, as attitude and risk

perception influences the preparation for any unforeseen events. As same as Zailani et al. (2012a), they suggested that “future research might compare the outcomes of SSCM before and after the adoption of SSCM practices” (p.338). Furthermore, Ambulkar et al. (2015) suggested research to create SRES between two of more organizations in supply chains, instead of within single organizations. In addition, Jüttner and Maklan (2011) advised that “further research should help to identify additional behavioural antecedents and support organizations in their endeavours to improve the resilience of their supply chains” (p.255).

Some papers have paid attention to advocating performance measurement in further research, as presented in Section 2.5. For example, Colicchia et al. (2013) explained that organizations should study and develop effective performance measurement systems to investigate the environmental impact of processes. Likewise, Taticchi et al. (2013) argued that there are some approaches integrating TBL with supply chain performance measurement. On the other hand, Carvalho et al. (2012b) stated that future research should study the main impact factors between SRES strategy and SC performance. Besides, Ponomarov and Holcomb (2009) advised that measurement tools would help organizations and SCs to determine which sections or factors of SRES should be developed. This measurement tools will provide important knowledge regarding the outcomes of SRES concept. Moreover, it can be seen that multiple measurement tools could investigate at each sub-factor level with appropriate objective measurements (Pettit et al., 2013).

Further, Govindan et al. (2014) suggested that it is essential to integrate SCM practices with TPL, i.e. environmental, economic and social, by applying Structural Equation Modelling to empirically test the proposed model. Moreover, Pettit et al. (2010) explained that measurement and implementation issues still need to be studied in order to enhance and develop a conceptual framework to provide successful managerial tools in the future. Further, Ahi and Searcy (2015) argued that there is no one metric, or group of metrics, which suit or fit all circumstances. However, the conceptual framework, which provides an obvious starting point for

processes and definitions, leaves the prioritization of specific metrics to decision-making in organizations.

Finally, Kamolkittiwong and Phruksaphanrat (2015) explained that there is a lack of research related to the influence of green supply chain strategy on business performance in the electronic industry in Thailand. Therefore, it may be concluded that Thai's electronic industry is also failing to assess the effect of SResSCM on organizational performance. According to these examples, few studies have taken place in a Thai context, and they are rarely published in academic journals, or in English. Thus, this study will provide a contribution to SResSCM research in Thailand. Further, the existing literature from SLR process for the study between SSCM and SRES field still quite low, as 24 of 385 papers were found for this thesis (Table 2.2). Moreover, although Table 2.7 showed that there is some research combining SSCM and SRES; however, there are still very few relationships emerged from the relevant literature.

As presented in Section 2.6, it can be seen that SSCM and SRES also support organizations to be more efficient and effective in their businesses. Moreover, as discussed above, it can be found that the clear definition and relation between SSCM and SRES still lacking in the relevant literature, and this thesis would like to fill this gap. Therefore, the following section presents a development of SResSCM framework, which initial developed from the literature, of this study.

Based on the review of the relevant literature as presented before, this study integrates four SSCM practices and four SRES practices together and combines the definitions of SSCM and SRES from the relevant literature into one definition of SResSCM. The reason to develop SResSCM framework is the researcher found that there are the relationship between SSCM and SRES in the existing literature and organizations also have SSCM and SRES concept in their procedures or policy, thus if organizations can improve SSCM and SRES concepts at the same time, it might be more beneficial for organizations, especially in developing countries such as Thailand. Thus, if organizations have these two concepts in their policy or strategy,

it will help them to work smoothly and improve their supply chains by becoming more sustainable and resilient. In addition, it would like to good impact to developed country as organizations in West Country that they would receive better products or service, which would to be sustainable and resilient than before. Furthermore, as mentioned earlier, some sustainable or resilient activities are used together; therefore, organizations could improve their performance by implementing the SResSCM practices from this study, which will suggest appropriate practices to help organizations become more sustainable and resilient in their supply chains.

An SSCM framework was provided by Ahi and Searcy (2013), Carter and Rogers (2008), Seuring and Müller (2008b) and so on, and the SRES framework was provided by Christopher and Peck (2004a), Fiksel (2006), Peck (2005), Pettit et al. (2010), Ponomarov and Holcomb (2009) and so forth. Nevertheless, the relationship between SSCM and SRES is still in the developing stage. Accordingly, this study will study the understanding and level of implementation on SSCM and SRES in organizations first, and then this study pays attention to integrating and developing a new framework of sustainable and resilient supply chain management (SResSCM), helping organizations to boost their sustainability and resilience.

Therefore, SResSCM is the integration of sustainable and resilient in supply chain management where resilient supply chain management is contingent with sustainable supply chain management. For the purpose of this study, the researcher proposed SResSCM definition as the materials, information and capital flows along the supply chains with three dimensions as environmental, economic, and social perspectives for the situation between before-during-after disruption periods by integrating vulnerability and capability factors to maintain continuity of operations at the desired level of connectedness and control over structure and function (Figure 2.24).

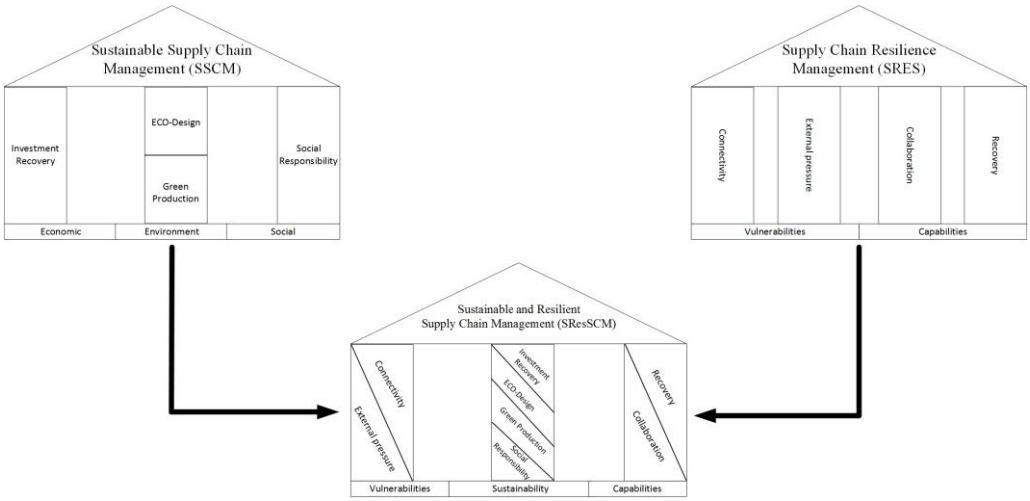

Figure 2.24: Initial Sustainable and resilient supply chain management framework (SResSCM)

Accordingly, the initial SResSCM practices from the literature review encompasses eight practices, i.e. ECO-design, green production, investment recovery, social responsibility, collaboration, external pressure, recovery and connectivity, as discussed in summary Section 2.4.2 for SSCM practices and Section 2.4.3 for SRES practices. These practices were reviewed that there are some relationships among them. So this concept will be used as the main idea and then it will be tested during this study.

Moreover, this study will suggest SResSCM practices, which can be implemented by organizations to help organizations and SCs to become more sustainable and resilient. These practices were adopted from the existing research, and studied using a three-methodological approach (described in Chapter 3). These SResSCM practices could boost organizations to become more sustainable and resilient, once they have successfully implemented them. Then, at the end of this thesis, it will be presented a valid measurement scale of SResSCM practices for performance improvement.

Further, this study will investigate organizational performance and supply chain performance when the concepts of SSCM and SRES are implemented. The findings will measure the current level implementation of SResSCM practices in organizations and guide policy's maker or organizations on the opportunities of

implementing SResSCM framework and practices in their organization. Consequently, the SResSCM definition, SResSCM practices, supply chain performance improvement, and organizations' impact will be summarized at the end of this thesis.

2.9 Development of research objectives and questions

The main aim of this study was to define the relationship between SSCM and SRES and then to develop a new definition of SResSCM and to investigate organizational and supply chain performance by integrating SSCM and SRES together, using measurements to develop tools to assess the current implementation level of SResSCM in organizations. This tool could help organizations to assess their own level of SResSCM and guide them in developing efficient SResSCM practices. The research objectives shown below for this study provided the development of the study model. Prior to developing research methodologies, the primary research aimed to identify a SResSCM framework and develop measurement tools in SResSCM to assess the performance in organizations and SCs. To achieve these goals, the research objectives were set as follows.

2.9.1. Research objectives

Regarding to the relevant literature and research gaps about SSCM and SRES, there has been less investigation about the relationship between SSCM and SRES at this moment. Thus, this thesis needs to study and develop SResSCM framework, which organizations around the world can apply and implement in their procedure and policy. Therefore, the research objectives of this thesis were proposed as following.

RO1. To study and test SResSCM concept

For RO1, the researcher needs to study the current concepts of SSCM and SRES in organizations and then to develop and test SResSCM concept, which leads to RQ1 and RQ2 of this study.

RO2. To test appropriate SResSCM measures for organizations and supply chains.

For RO2, the researcher needs to study current measures, which organizations used and create and test SResSCM measures, which organizations can use to measure their current practices and prepare for further improvement in the future with SResSCM concept. This objective leads to RQ3 and RQ4 of this study.

Based on the research objectives for this study, and to fulfil all the purposes above, four research questions have been developed and formulated based on the existing literature review that were reviewed in this chapter.

2.9.2. Research questions

RQ1. What is the current level of understanding and implementation of SSCM and SRES in organizations?

Regarding to SSCM and SRES concept, it can be seen in the extant literature that organizations have been adopting these concepts into their organizations already. So it therefore firstly needs to study the understanding and level of implementation of SSCM and SRES concept in organizations. This study explores qualitative study to determine scope/theme at the first step and then test with quantitative study in the second step. So the results of this study will combine the findings from qualitative and quantitative study together.

RQ2. What could be a suitable framework of sustainable *and* resilient supply chain management (SResSCM)?

Some studies addressed the relationship between SSCM and SRES, but there is no one has been confirmed regarding to the relationship between SSCM and SRES. Most of studies paid attention on individual SSCM dimensions or SRES dimensions. Conversely, there is a lack of focus on the combination between SSCM and SRES in terms of definition and practices. It therefore secondly aims to explore a suitable framework of sustainable and resilient supply chain management is.

RQ3. What would a valid measurement scale of SResSCM practices for performance improvement?

Some studies addressed the performance measurement in SSCM and SRES many researches focused on individual SSCM or SRES dimensions. Therefore, this thesis needs to explore a measurement scale that can assess the level of implementation on SSCM and SRES practices in organization at the same time, which will be supported organizations to improve in which practices that organizations still lack or might be improved first. The researcher needs to define that which scales are important in organizations and also studies how organizations respond to SResSCM practices implementation level scale?

RQ4. What is the impact of SResSCM practices on supply chain performance and organizational performance?

Related to Section 2.5, SSCM and SRES concepts and practices also have the impact on supply chain performance and organization performance. However, organizations need to aware the impact to implement these concepts during decision step before implemented. Thus, this thesis will provide possible improved supply chain performance and possible impact to organizational performance after organizations implemented SResSCM practices successfully.

2.10 The conceptual model and hypothesis development

The main reason for the developed model was to clarify the conceptual logic and provide the direction of this study. It supports important ideas and assists in describing the emphasis of the study concept. Some literature/researchers have often focused on a single definition, i.e. SSCM or SRES, as explained in Section 2.6; however this study tries to combine these two definitions together, developing measurement tools to investigate SResSCM practices in organizations. According to the research gaps and SResSCM framework highlighted in Section 2.8, this study combines SResSCM combines four practices from SSCM and four practices from SRES, which relate to the existing literature and existing scale, as SResSCM practices. Figure 2.25 presents the conceptual model and hypotheses for this study.

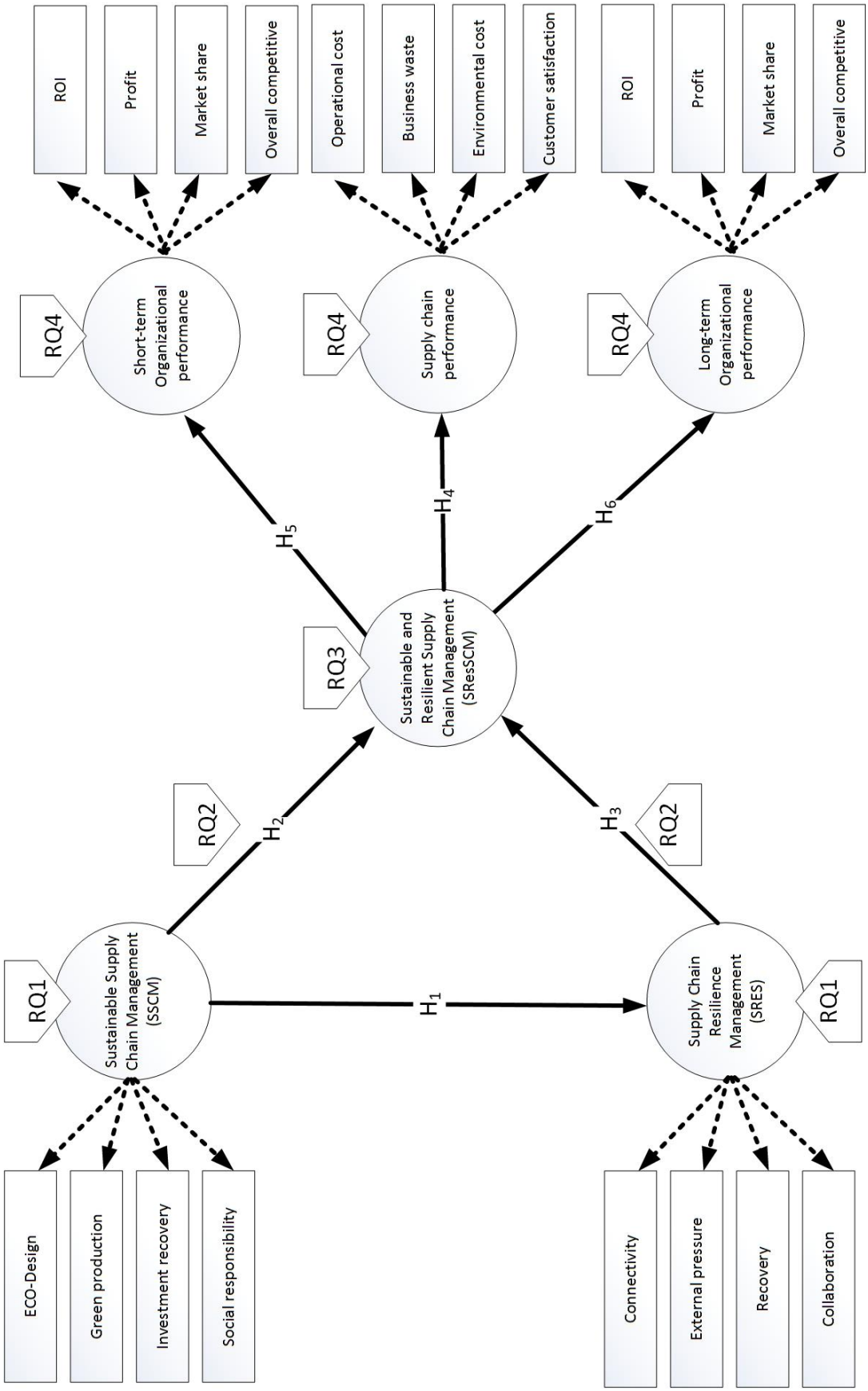

Figure 2.25: Conceptual Model for this research

Figure 2.25 presented the overall concept for this study. It can be seen that there are four research questions and six hypotheses. Further, it showed that SResSCM concept is influenced by SSCM and SRES and then SResSCM concept influences SC performance, short-term organization performance and long-term organization performance. In this figure, SSCM concept and SRES concept consists of four practices each, as ECO-design, green production, investment recovery for SSCM concept and connectivity, external pressure, recovery and collaboration for SRES concept. By study the relationship between SSCM and SRES as H_1, the researcher also study about the level of the understanding and implementation of SSCM and SRES in organizations as RQ1 as well. Moreover, it can be seen that H_2 and H_3 are pointing from SSCM and SRES concept to SResSCM concept, these hypotheses would help the researcher to study and develop SResSCM framework, which use to answer RQ2 and fulfill RO1 of this thesis. After that, in SResSCM concept, it uses to answer RQ3, which uses to define a valid measurement scale of SResSCM practices by studying and developing SResSCM measurement scale from the existing literature and then test with Thai's organizations via survey (Phase Two) and then validate and confirm with interview (Phase Three).

On the other hand, H_4, H_5 and H_6 use to study the relation between SResSCM practices on supply chain performance (such as operational cost, business wastage, environmental cost and customer satisfaction) and organization performance (in term of short-term and long-term impact such as return on investment, profit margin, market share, overall competitive and so forth), these hypotheses use to complete RQ4 and RO2 of this thesis, which the researcher wish to assess the impact of the implementation SResSCM practices on performance.

As noted in Section 2.4.3, contingency theory (CT) is relevant as a theoretical lens (Lawrence and Lorsch, 1967) because it relates with organizational performance and supply chain performance due to internal and external factors. SRES deals with risk factors while SSCM is concerned about the natural environment, however there are many correlated issues so contingency theory will provide a prism to view the integration between SSCM and SRES in Thai's industry. CT suggests that there is no

universal set of choices that is optimal for all business (Ginsberg and Venkatraman, 1985). But the role of CT is to identify the driving force that enables organizations to adopt and implement SResSCM practices. Moreover, CT also suggests that the fit between organizational structure and environment will enhance business performance (Park, 2011). With CT, the results may depend on the chosen strategy of the organizations, the structure of their SCs (e.g. customers, suppliers and source of uncertainties) and other factors (Trkman and McCormack, 2009).

Moreover, this study also pays attention on stakeholder theory (ST) (such as customers, suppliers and shareholders) because the aim of this study is to improve organizations and supply chains to be more sustainable and resilient in the future. As Sarkis et al. (2011) explain that "stakeholder theory suggests that companies produce externalities that affect many parties (stakeholders) which are both internal and external to the firm. Externalities often cause stakeholders to increase pressures on companies to reduce negative impacts and increase positive one" (p.9). The stakeholder theory is usually introduced as an exploratory theory related to antecedents or contingencies for adoption of SResSCM practices.

In summary, CT supports to produce the result for this study as CT helps to predict that SRES is contingent on SSCM or SSCM is contingent on SRES as the purpose of RO1. While ST supports to produce the result for this study as when organizations do something that provide directly or indirectly affect a variety or groups around the organizations, as purpose of RO2 and so that perspective, ST really appropriate theory for this thesis. Therefore, this thesis base on theoretical framework of contingency theory and stakeholder theory because organizations in Thailand may implement practices from SSCM and SRES based on the contingency of internal and external factors.

The conceptual model and hypotheses testing were developed to investigate the relationship between SSCM and SRES (H_1), the relationship between SSCM definition (H_2) and SRES definition (H_3) to SResSCM practices, the impact of SResSCM practices on supply chain performance (H_4), short-term organizational

performance (H_5), and long-term organizational performance (H_6). These hypotheses related to all research questions in Section 2.9.2 and it would fulfil all research objectives for this study. The information from each hypothesis is explained following.

2.10.1. Contingent relationship between SSCM and SRES

According to Section 2.6, there has been some research combining SSCM and SRES together; however, there is no single study devoted specifically to this relationship. The studies of Azevedo et al. (2012); Azevedo et al. (2013b); Govindan et al. (2015); Ponomarov and Holcomb (2009); Soni et al. (2011) and so on provide the linkage between SSCM and SRES in different interactions. Based on RO1 and RQ1, this study applies SSCM and SRES concepts from the relevant literature. Regarding to SSCM, which consists of environment, economic and social dimensions (Carter and Rogers, 2008; Seuring and Müller, 2008b), while, SRES for this study focus on the combination between vulnerabilities and capabilities factors (Pettit et al., 2010; Pettit et al., 2013). Because the researcher believe that these factors have interaction together, they developed an integrated SResSCM definition, including and practices from both SSCM and SRES definitions as there are interlinks between SSCM and SRES appear in the relevant literature.

The model has been developed from the existing concepts in the SSCM and SRES field for measuring organizational performance and supply chain performance, and SResSCM impact. SSCM practices involve environment, economic and social perspectives. SRES practices can be classified into vulnerability and capability. H_1 will help to study the relationship between SSCM and SRES concept. The current level of understanding and implementation level of SSCM and SRES from organizations with this hypothesis would support to complete RQ1 of this thesis. Therefore, the following hypothesis is proposed:

Hypothesis 1

- H_1: Sustainable supply chain management has a positive relationship on supply chain resilience management

2.10.2. Sustainable supply chain management definition and practices

Carter and Rogers (2008) defined SSCM with three dimensions, i.e. environment, economic and social perspective. Therefore, in this thesis SSCM practices are related to the extant literature. This study focuses on ECO-Design (Green et al., 2012; Zhu et al., 2008), green production (Azevedo et al., 2013b; Zhu et al., 2008), social responsibility (Mellat-Parast, 2013) and investment recovery (Green et al., 2012; Rao and Holt, 2005; Zhu et al., 2008). The explanations for each perspective as are follows:

Organizations and SCs are forced from social and other dimensions to adopt or apply ecologically responsive practices to fulfil legislative requirements (Vachon and Klassen, 2008; Zhu and Cote, 2004). Moreover, environmental sustainability is an essential element for the entire supply chain, rather than the individual organization (Vachon and Klassen, 2006, 2007). Thus, organizations need to encourage their supply chains to become more sustainable, support their suppliers and also involve their customers in enabling the production to be greener in the future. For instance, Zailani et al. (2012a) demonstrated that ECO-Design has an influence on the regulation of environmental performance in organizations. Further, Green et al. (2012) argued that eco-friendly design has a directly positive influence on environmental performance, as the impact of the design process is to reduce the environmental impact. While green production, such as environmental purchasing, cleaner production and internal environmental management, is selected for this study because the relevant literature showed that green production has a direct impact on environmental performance (Choi and Hwang, 2015; Govindan et al., 2013).

For this study, investment recovery is selected as economic dimension of SSCM for this study because during reviewing the existing literature, it can be found that most of papers focus on investment recovery practices rather than other economic practices (Chan et al., 2010; Choi and Hwang, 2015; Guide, 2000; Spicer and Johnson, 2004; Zhu et al., 2008). Therefore, investment recovery is an economic practice, which requires the sale of excess inventories, scrap, used materials and

excess capital equipment (Zhu et al., 2008). Rao and Holt (2005) studied the relation between green supply chains and economic performance, and found that GSCM practices provide better economic performance and competitive advantages for organizations.

The field of operations/production management is consistently looking for new approaches to effectively improve organizational processes and routines, and enhance organizational performance (Mellat-Parast, 2013). Corporate Social responsibility in this thesis is the social practice, which was discussed a lot in the existing literature (Cruz and Wakolbinger, 2008; Govindan et al., 2013; Sarkis et al., 2010), that a company uses in dealing with employees, society and the outside world. The definition of social practice is the ability to maintain the well-being of workers and society surrounding the company, sub-factors being workers' welfare and social impact. According to Mellat-Parast (2013) research, the implementation of corporate social responsibility has a positive effect on the formation of the 'moral capital' of a firm by enhancing employee involvement.

However, SSCM from the literature might or might not relate to practices in organizations. Moreover, H_2 also related to RQ2 as it helps to develop and define the suitable and appropriate framework of SResSCM for this study. In summary, this study pays attention on four constructs of SSCM practices, i.e. ECO-design, green production, investment recovery and social responsibility because these practices have been received more attractive from academics and practitioners. Then, the following hypothesis for sustainable supply chain management is proposed:

Hypothesis 2

- H_2: Sustainable supply chain management definition has a positive effect on sustainable and resilient supply chain management practices

2.10.3. Supply chain resilience management definition and practices

Regarding to Section 2.4.3, this study adopts SRES definition from Chopra and Sodhi (2014); Christopher and Peck (2004a); Jüttner and Maklan (2011); (Rice, 2011) and

so on and applied SRES practices from Pettit et al. (2010) and Pettit et al. (2013), who using two constructs, vulnerabilities and capabilities factor, to build the balance of resilience in organizations. The model admits the need to balance managerial capabilities with the inherent vulnerabilities of the supply chain design and the environment in which it operates (Pettit et al., 2010). Moreover, Pettit et al. (2010) explained that "supply chain resilience increases once capabilities increase and vulnerabilities decrease" (p.6). As Pettit et al. (2013) described from their study that connectivity and external pressure as two vulnerability factors which have a huge impact on organizations. Furthermore, recovery in the capability factor has potential influence to increase organizational performance, while the low collaboration factor provides more concern to organizations (Pettit et al., 2013). Consequently, this study integrates connectivity, external pressure, recovery and collaboration factor into a triple-bottom-line (TBL) framework, and incorporate SSCM framework and SRES framework into a SResSCM framework. Moreover, after the researcher had reviewed sub-level of vulnerability and capability factors, it can be found that all of these sub-factors have direct impact on sustainability dimensions. Thus, these SRES practices are appropriate for this study. Definitions of each construct follows below.

The concept of SRES in some previous studies is explained by Pettit et al. (2013) that vulnerabilities as "fundamental factors that make enterprise susceptible to disruption, for example external pressures, deliberate threats, and resource limits" (p.69). Moreover, Sheffi and Rice (2005) suggested that vulnerabilities can be assessed in terms of risk, and a combination of the likelihood of an event and its potential severity. These definitions are based on traditional risk management techniques and are escalated by other authors (Svensson, 2002). Further, Pettit et al. (2013), argued that external pressure and connectivity represent important vulnerability factors of organizations.

Pettit et al. (2013) defined supply chain capabilities as "attributes that enable an enterprise to anticipate and overcome disruptions" (p.69). Capability factors can protect against actual disturbance (i.e. security measures deterring a terrorist

attack), relieve the effects of a disruption (i.e. stockpiles of emergency supplies), or enable adaption following a disruption. Moreover, Lee (2004) showed methods to promote short-term and long-term change according to three key capabilities as: agility, adaptability and alignment. Consequently, this study focuses on the recovery and collaboration practices of capability factor according to the study of Pettit et al. (2013), who advocated "capability strength in the areas of market position, recovery, and financial strength consistent reports that low collaboration, lack of excess capacity, and minimal flexibility provided serious concerns to the organizations" (p.57).

As with the SSCM concept, SRES definition may or may not relate to SRES practices in organizations. Thus, the following research hypothesis for supply chain resilience management is proposed:

Hypothesis 3

- H_3: Supply chain resilience management definition has a positive effect on sustainable and resilient supply chain management practices

Accordingly, H_2 and H_3 will collaborate together to answer RQ2 and support the development and improvement of RQ3 for this study.

2.10.4. Supply chain performance and organizational performance

As presented in Section 2.5 about performance measurement in SSCM and SRES, it can be seen that there are some measurements emerged from the existing literature. After considering the arguments from literature review, in this thesis, supply chain performance is measured with four variables as 1) operational cost, 2) business wastage, 3) environmental cost and 4) customer satisfaction (Govindan et al., 2015) . According to Azevedo et al. (2013a), these measurements are validated as the construct of "Supply Chain Performance". Therefore, this study will analyse the impact of SResSCM in an organization and supply chain performance. Moreover, supply chain performance is an important factor for better

understanding of the main characteristics of supply chain (Azevedo et al., 2013a). The definition for each variable is as follows:

- Operational cost – "it is related to the expenses of running a business; it includes production costs, transportation costs and inventory holding costs, among others. It is an important aid to making judgments and decisions, because its purpose is to evaluate, control and improve operational process" (p.231) (Jeffery et al., 2008).
- Business wastage – "it is used in its broader sense including typical lean wastages, e.g. effects in products, excessive inventory, excessive lead-time, excessive scrap, excessive transportation" (p.49) (Singh et al., 2010) and "also solid and liquid wastes, percentage of materials remanufactured, recycled and re-used, hazardous and toxic material output" (p.19) (Govindan et al., 2015).
- Environmental cost – "it is crucial to have information about environmental practice's costs to scrap/rework (p.1178) (Christiansen et al., 2003), disposal (p.4993) (Tsai and Hung, 2009), purchasing environmentally friendly materials (p.459) (Zhu et al., 2005) and certification, among others".
- Customer satisfaction – "the degree to which customers along the supply chain are satisfied with the product and/or service received (p.278) (Beamon, 1999). It includes after-sales service efficiency, rates of customer complaints, stock-out ratio, delivery time, among other indicators (p.19) (Govindan et al., 2015)".

Attending to the relevant literature and the research gaps, the identification of the relationships between SResSCM practices and supply chain performance is critical to a better understanding of the main characteristics of supply chain performance. Thus, the following hypothesis is proposed:

Hypothesis 4

- H_4: Sustainable and resilient supply chain management practices positively affect supply chain performance

Furthermore, this study will analyse the impact of SResSCM on short and long-term organizational performance, which refers to how well an organization achieves its market-oriented goals (Li et al., 2006). The time-line to separate this period as short or long-term is: 1) if the impact occurs within three years, it is called short-term impact, while, if the impact occurs after three years, it is called long-term impact. Some studies, such as Tan et al. (1998b), have classified organizational performance into short-term and long-term objectives. The short-term objectives of SCM are mostly to improve productivity and reduce inventory and cycle time, while the long-term objective is to improve market share. Furthermore, according to Pettit et al. (2010), "resilience is a characteristic of SCs in order to survive in the short-term, but also provides the ability to adapt to change in the long-term". Moreover, management strategies are beginning to recognize that SRES will attempt to be the 'ultimate competitive advantage in an age of turbulence' (Hamel and Valikangas, 2004). Furthermore, some studies have acknowledged the impact of SCM, SSCM and SRES practices on organizational performance, such as Green and Inman (2005); Green et al. (2012); Li et al. (2006); Zhu et al. (2008) and so forth. There are some measured organization performance using in the existing literature, such as market share, return on investment (ROI), profit margin in sales, the growth of ROI, sales and market share and overall competitive position (Li et al., 2006; Tan et al., 1998b). Thus, the following two hypotheses are proposed:

Hypothesis 5

- H_5: Sustainable and resilient supply chain management practices have a positive impact on short-term organizational performance

Hypothesis 6

- H_6: Sustainable and resilient supply chain management practices have a positive impact on long-term organizational performance

Therefore, H_4, H_5 and H_6 will help to answer RQ4 and also support the development of implementation level measurement scale for SResSCM practices, which used to verify and complete RQ3 for this thesis.

2.11 Summary of chapter

This chapter has presented different concepts of SCM, SSCM, and SRES obtained from the SLR process. Even though there were various definitions, the major objective of this chapter was to review the relevant literature and then develop a new framework for SResSCM from the existing literature.

The results from the SLR process demonstrated some interesting points on the topic of SResSCM during the last two decades. While there have been some newly published papers in different journals, it seems there are no papers investigating the relationship between SSCM and SRES.

The principal difference between SSCM and SRES is in focus: SSCM aims to minimize environmental impact, improve social responsibility and enhance profit over the long-term period, while SRES seeks to overcome disruption by preparing a strategy for supply chain members to use in different incidents. Then, the initial SResSCM framework and practices were explained after conducted the relevant literature. The development of research objectives and research questions, the conceptual model and hypotheses testing were presented in this chapter at this end of this chapter. The next chapter contains the research methodology with research paradigms, research design and a three-phased methodological approach for this study.

Chapter 3 RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses introduces the methodology developed for this study. According to the development of research objectives and in Chapter 2, this study applied a quantitative research approach (Phase Two) with survey and structural equation modelling (SEM) as the main methodology. Interview technique was used to collect data for Phase One (semi-structured interview) and Phase Three (structured interview). The study collected data from the Thai manufacturing sector, i.e. electrical, electronic and automotive industries to complete the research aims of understanding SResSCM in organizations, applying the conceptual model developed. This is followed by discussions about the research process (Section 3.2), research design (Section 3.3) and research method (Section 3.4 to 3.6) used in this study. The research ethics (Section 3.7) are discussed in the final section of this chapter. This chapter can be summarized as an introduction to the presentation of the research findings in Chapter 4 through to Chapter 6.

3.2 Research process

According to the research gaps demonstrated in Section 2.8, this process combined reviews of the original ideas, analyzing the research gaps alongside the research area. Regarding to Section 2.9, potential research questions were created from the research problems. The existing literature was reviewed in detail to define which relevant questions had been answered already. The research objectives were developed according to the selected research questions derived from the main aims of the study. In order to answer the research questions, the existing literature was further investigated to create possible theory. The literature was reviewed in several areas, such as SCM, SSCM and SRES, and the concept of a SResSCM framework was created and developed, all measurement factors being defined based on the relevant existing literature. Moreover, according to previous processes, a set of possible performance measurement factors was tested in the context of Thai manufacturing. Measurement factors were investigated and

validated by a suitable panel of experts to generate amendments from academics and practitioners' perspectives.

Furthermore, the data collection included a quantitative approach, using survey as the main data gathering method, and interviews, both semi-structured and structured, to generate understanding from the practitioner's perspective in the supply chain. This mixed method consisted of data triangulation, employing survey, interview for data analysis.

3.2.1. Philosophical issues in research

Philosophical issues are essential components of research study, because researchers need to understand their perspective in selecting a suitable philosophy, through which to view possible findings. Research philosophy is used to gain understanding when doing research, and consists of research design, research methodology and research methods. At this moment, there are numerous research paradigms, so researchers need to identify and select suitable paradigms for their study.

Easterby-Smith et al. (2002) explained the reasons why researchers should be aware of philosophical issues. First of all, philosophical issues help to clarify research designs, including what kind of evidence is required and how to answer the research questions. Secondly, they help researchers to choose appropriate research designs. Lastly, philosophical issues help researchers to determine the constraints of different subject or knowledge structures when selecting an appropriate research design. Research paradigm is an important topic for research design for all areas of academic research (Mangan et al., 2004). Different paradigms can be divided into three main topics as: 1) how they view the world and perceived truth, 2) relationships between research and researchers and 3) how the research studies the truth (Näslund, 2002).

3.2.1.1 Research philosophy

Research philosophy, or research paradigm, refers to a "framework that guides how research should be conducted, based on people's philosophies and their assumptions about the world and the nature of knowledge" (Collis and Hussey, 2009). The selected research strategies and methods will be underpinned by these assumptions. This implies that researchers should select a suitable research methodology with thorough consideration of the research paradigm. Research philosophy includes ontology, epistemology, methodology and methods. A definition of these is shown in Table 3.1.

Table 3.1: Ontology, epistemology, methodology, and method (*Source: Easterby-Smith et al. (2002), p.31)*

Ontology	Assumption that we make about the nature of reality
Epistemology	General set of assumptions about the best ways of inquiring into the nature of the world
Methodology	Combination of techniques used to enquire into a specific situation
Methods	Individual techniques for data collection, analysis, etc

Burrell and Morgan (1979) illustrated two extreme positions of research philosophy, as shown in Figure 3.1. Moreover, Morgan and Smircich (1980) provided "a rough typology for thinking about the various views that different social scientists hold about human beings and their world" (p.492), as demonstrated in Figure 3.2.

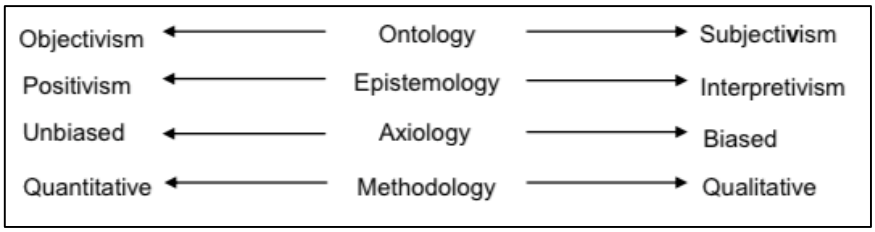

Figure 3.1: The objective-subjective dimension *(Source:* Burrell and Morgan (1979), p.3*)*

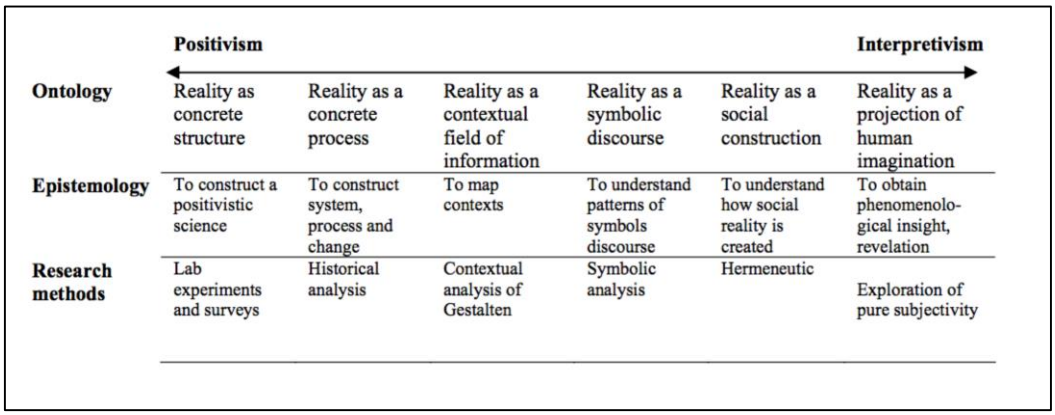

Figure 3.2: Principle Assumptions on a Continuum of Paradigms in Social Science *(Adapted from* Morgan and Smircich (1980) p.492*)*

3.2.1.2 Ontology

Beginning with ontology, which is the starting point for most of the debates among philosophers, Bryman and Bell (2011) defined it as the opinion of what is the truth. Ontology, which comprises of subjectivism and objectivism, focuses on the nature of reality. Subjectivism refers to an organization as a social construct, which is therefore permanently revised by its inhabitants. On the other hand, objectivism means that participants have to follow an externally given reality (Bryman and Bell, 2011). Normally, subjectivism is aligned with the epistemological view of interpretivism, and objectivism comes with the epistemological view of positivism. Their differences can be illustrated by reference to two of the most common central terms in social science - organization and culture (Bryman and Bell, 2011).

Moreover, Bryman and Bell (2011) defined objectivism as “an ontological position that asserts that social phenomena and their meaning have an existence that is independent of social actors” (p.21), whereas they, explained subjectivism or constructivism as “an ontological position, which asserts that social phenomena and their meaning are continually being accomplished by social actors” (p.22) Bryman and Bell (2011) .

3.2.1.3 Epistemology

According to Saunders et al. (2007), epistemology means "what constitutes acceptable knowledge in the field of study" (p.112). Meanwhile, Bryman and Bell (2011), defined epistemology as "acceptable knowledge in the discipline" (p.15). Epistemology consists of two main points, which are positivism and interpretivism (Collis and Hussey, 2009). Positivism and interpretivism take entirely opposing sides in epistemology. Positivism perspective is most quickly achieved through the design of experiments for key factors, which are assessed accurately in order to test predetermined hypotheses (Easterby-Smith et al., 2002). Bryman and Bell (2011) defined the principles of positivism as being "to generate hypotheses that can be tested. Only phenomena and hence knowledge confirmed by the senses can genuinely be warranted as knowledge. Knowledge is arrived at through the gathering of facts that provide the basis for laws; science must be conducted in a way that is value free" (p.15). Conversely, with the interpretivism perspective, which does not assume any pre-existing reality, the aim of the researchers is "to understand how people invent structures to help them make sense of what is going on around them" (p.34) (Easterby-Smith et al., 2002). Table 3.2 demonstrates the relationship between the three main epistemologies and methods in social science.

Table 3.2: Methodological implications of different epistemologies within social sciences *(Source:* Easterby-Smith et al. (2002), p.34*)*

	Social Science Epistemologies		
	Positivism	Relativism	Social Constructionism
Elements of Methods			
Aims	Discovery	Exposure	Invention
Starting points	Hypotheses	Suppositions	Meanings
Designs	Experiment	Triangulation	Reflexivity
Techniques	Measurement	Survey	Conversation
Analysis/interpretation	Verification/falsification	Probability	Sense-making
Outcomes	Causality	Correlation	Understanding

3.2.1.4 Axiology

Saunders et al. (2007) pointed to axiology as "a branch of philosophy that studies judgments about values" (p.116). Axiology studies the role of the researcher's values during the research process, and how these values may impact the

credibility of the research (Saunders et al., 2007). Moreover, Saunders et al. (2007) suggested that researchers need to choose various sources, to focus on the object and select methods which do not allow the influence of bias. These values assist in deciding what to recognize as facts, and the interpretations which are drawn from them (Collis and Hussey, 2009). The integration between ontology, epistemology and axiology is known as a paradigm (Easterby-Smith et al., 2002).

3.2.1.5 Methodology

Research methodology is a critical part of research study, and is related to the research questions. There are two main areas of research methodology, known as qualitative and quantitative approach. Hair et al. (2010) demonstrated how quantitative research methods are mainly used with descriptive and causal research designs, but are occasionally associated with exploratory research. Quantitative research is a strategy that mainly deals with large samples to test for statistical significance in a population, and analyses the relationship between the variables (Bryman and Bell, 2011), being associated with the positivist paradigm (Hair et al., 2010).

Qualitative research, on the other hand, pays attention to words rather than numbers (Bryman, 2003). Qualitative methods provide sets of data collection and analysis technique that can be used to provide description, build theory and test theory (Bryman and Bell, 2011). Easterby-Smith et al. (2002) suggested that researchers should collect more data using different research methods but the same paradigm.

The main aims of this study are to: (1) develop and define a new framework of sustainable and resilient supply chain management (SResSCM); (2) develop measurement tools for assessing the implementation level for SResSCM practices; (3) investigate the impact of SResSCM practices on SC performance and organization performance. Therefore, the study applied an inductive approach, using interviews to study and define the SResSCM variables, which practitioners

used in organizations. According to “what” type of research questions, there was also a requirement for testing SResSCM practice variables for statistical significance on a larger population from organizations, to build and develop a new theory. Deductive approach was applied to fulfil the research objectives, using this technique as a survey instrument. Consequently, validation was required to support the overall findings from all phases of this study.

3.2.1.6 Paradigms and debate

A paradigm encompasses ontology, epistemology and axiology (Guba and Lincoln, 2005). Positivism or interpretivism are types of research paradigm. Bryman (2003) described the term of paradigm as “a cluster of beliefs and dictates which for scientists in a particular discipline influence what should be studied, how research should be done, and how results should be interpreted” (p.24). Moreover, Kuhn (1996) offers a definition of paradigm as “an entire constellation of beliefs, values and techniques, and so on, shared by the members of a given community” (p.175). A paradigm helps researchers to examine social phenomena from among appropriate phenomena that provide more understanding and can gain more information from research (Saunders et al., 2007). In addition, Collis and Hussey (2009) suggested that a paradigm helps researchers to provide a set of theories, methods and way of defining data. Comparisons between different paradigms based on ontology, epistemology and methodology can be seen in Table 3.3.

The nature of positivism tends to be objectivism, excluding biases and normally requiring a quantitative research approach. On the other hand, interpretivism tends to be subjectivism, including biases and using a qualitative research approach. Positivism plays a fundamental role in supply chain management (Golicic and Davis, 2012; Mangan et al., 2004; Näslund, 2002), because SCM tends to be multi-discipline in nature, i.e. economics, engineering, or business. Mangan et al. (2004) mentioned Logistics Research has benefited enormously from the development of generalized theory and knowledge according to scientific background.

Table 3.3: Comparisons of Characteristics of research perspectives *(Sources:* Teddlie and Tashakkori (2009), p.88*)*

Dimension of Contrast	Positivism	Postpositivism	Pragmatism	Constructivism
Methods	Quantitative	Primarily quantitative	Both qualitative and quantitative; researchers answer questions using best methods	Qualitative
Logic	Hypothetico-deductive (originally inductive)	Hypothetico-deductive	Both inductive and hypothetico-deductive	Inductive
Epistemology (researcher/par ticipant relationship)	Objective point of view (dualism)	Modified dualism	Both objective and subjective points of view, depending on stage of research cycle	Subjective point of view; reality co- constructed with participants
Axiology (role of values)	Value-free inquiry	Values in inquiry, but their influence may be controlled	Values important in interpreting results	Value-bound inquiry
Ontology (The nature of reality)	Naïve realism (an objective, external reality that can be comprehended)	Critical realism (external reality that is understood imperfectly and probabilistically)	Diverse viewpoints regarding social realities; best explanations within personal value systems	Ontological relativism – multiple, constructed realities
Possibility of causal linkages	Real causes temporally precedent to or simultaneous with effects	Causes identifiable in a probabilistic sense that changes over time; internal validity important	Causal relations, but they are transitory and hard to identify; both internal validity and credibility important	Impossible to distinguish causes from effects; credibility of descriptions important
Possibility of generalization	Nomothetic statements possible	Modified nomothetic position; external validity important	Ideographic statements emphasized; both external validity and transferability issues important	Only ideographic statements possible; transferability issues important

Moreover, Saunders et al. (2007) provided a suggestion to debate on ontology and epistemology that researchers would be adopting the position of the pragmatist. They conclude the selection of research paradigm to pragmatic as, "if the research question does not support unambiguously that either a positivist or interpretivist philosophy is adopted, this confirms the pragmatist's view that it is perfectly possible to work with variables in your epistemology, ontology and axiology" (p.109). Furthermore, Bergman (2008) also argued that "The decision on whether the researcher deals (or, better, wants to deal) with one single reality, a constructed reality, multiple realities, multiple constructed realities, a co-constructed reality between the researcher and the researched, or no reality at all is unrelated to whether patterns in the data are detected via statistical analysis or otherwise" (p.16).

Teddlie and Tashakkori (2009)p.4) summarized methodological communities in social and behavioural sciences into three main ideas as:

- "Quantitatively oriented researchers – who primarily work within the 'postpositivist/positivist' paradigm",

- “Qualitatively oriented researchers – who subscribe to a paradigm known as ‘constructivism’ and its variants”,
- “Mixed methodologies – those who are philosophically oriented to the ‘pragmatism’ or ‘transformative perspective’ paradigm”.

Accordingly, the researcher believes that pragmatism, which applied both quantitative and qualitative approach, is more suitable for this study and this concept will be further explained in the next section.

3.2.1.7 Philosophical stance of this thesis

As noted in sections 3.2.1.2 to 3.2.1.6, philosophical, epistemological and ontological viewpoints of research have an effect on a methodological approach. Burrell and Morgan (1979) highlighted the difference between using positivism and non-positivism paradigms, to “conceptualize social science in terms of four sets of assumptions related to ontology, epistemology, human nature and methodology” (p.503). Accordingly, as presented in Section 2.3, most of paper in the literature dominated by quantitative studies, i.e. survey, based upon the positivism paradigm; however, nowadays qualitative studies in supply chain were gain more interesting increasing in the last decade. Moreover, it is important that all researchers must be aware about their own paradigm, which will influence to their research and how it is conducted, even though there is no right and wrong paradigm.

The researcher is concerned with understanding practitioner’s perception in Thailand about SSCM and SRES, which were developed to SResSCM for this study. The research questions are largely exploratory in nature seeking to understand and explain more about SResSCM as research phenomena. On the other, the researcher also needs to develop measurement scale/tools that organizations around the world can use to assess their performance with SResSCM practices, i.e. a quantitative and explanatory approach. Hence, as discussed in Section 3.2.1.6 pragmatism was applied as an epistemological stance for this thesis as the purpose

of this thesis is to define and test SResSCM variables, which are important to organizations.

As a result, the study first required an inductive approach, using in-depth interviews, to identify which SResSCM variables are important for organizations and which SResSCM practices are being currently used/implemented and why. Consequently, in-depth interviews (a qualitative approach) with experienced practitioners were determined to be a useful way to develop this in-depth understanding of SResSCM. After that, there was a requirement to test these SResSCM variables for statistical importance and significance on a large sample size (a quantitative approach). Thus, a survey was sent to firms in Thailand's electrical, electronic and automotive industry sector to test these variables to determine whether a larger number of industry respondents concurred with the variable.

As SResSCM is relatively new to the logistics and supply chain management domain it requires a degree of exploration and testing to help build theory. However, to summarize a new framework, scale measurement and the impact of SResSCM, the researcher needed to use an inductive approach again, collecting data via structured interviews in Phase 3, to validate and confirm the findings from Phase One (semi-structured interviews) and Phase Two (survey). Thus, the researcher believes that findings generated from these quantitative and qualitative approaches complement one other and results in better information to answer the research questions.

These three phases comprised an appropriate approach to achieve the research objectives. Due to the research questions being largely exploratory, some validation and explanation was required to propose new measures for the wider society. In summary, this thesis adopts pragmatism paradigm and adapt quantitative and qualitative procedures to answer the research questions. Thus, this is a useful way of extending the exploratory range of this thesis for studying and testing SResSCM concept in Thailand.

3.3 Research design

Easterby-Smith et al. (2012) defined research design as the general plan of research activities aimed at answering the research questions, and comprising of:

1. Clear research purposes and objectives;
2. Data collection method;
3. Specified sources of data to be collected;
4. Constraints of the research;
5. Ethical issues.

Moreover, Easterby-Smith et al. (2002) focused on the implications created by the design of management research. There is a clear difference between the positivist and social constructionist world-views, and sharp contrasts of idea exist between researchers about the desirability of methods, and the practice of research, as stated in Figure 3.3.

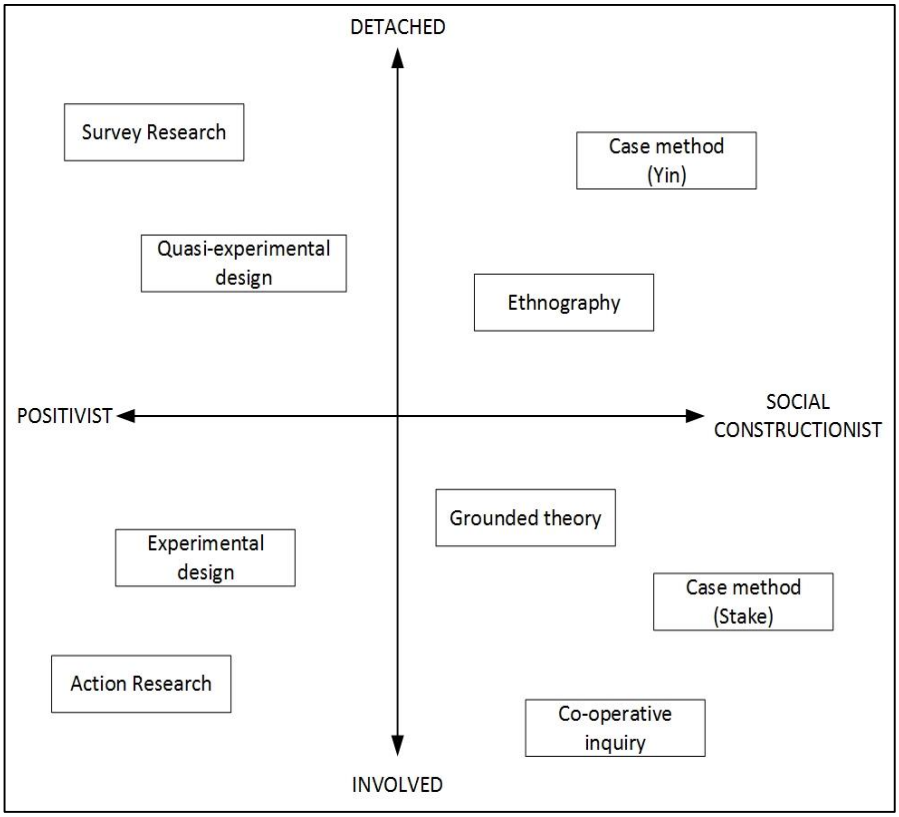

Figure 3.3: Matrix of research designs *(Source:* Easterby-Smith et al. (2002), p.57*)*

For the area of social science, there are various research methodologies. A suitable methodological alternative is related to the research paradigm for each study. Ellram (1996) suggested a guideline for selecting paradigm and research methods for research study, as presented in Table 3.4.

Table 3.4: Classification of research methods according to key research objectives and questions *(Adapted from Ellram (1996))*

Objective	Question	Examples of Appropriate Methodologies
Exploration	How, why How often, how much, how many, who, what, where	Qualitative • Experiment • Case study • Participant observation Quantitative • Survey • Secondary data analysis
Explanation	How, why	Qualitative • Experiment • Case study • Grounded theory • Participant observation • Ethnography • Case survey
Description	Who, what, where, how many, how much Who, what, where	Quantitative • Survey • Longitudinal • Secondary data analysis Qualitative • Case study • Experiment • Grounded theory • Participant observation • Ethnography • Case survey
Prediction	Who, what, where, how many, how much Who, what, where	Quantitative • Survey • Longitudinal • Secondary data analysis Qualitative • Case study • Experiment • Grounded theory • Participant observation • Ethnography • Case survey

3.3.1. Triangulation

Research that uses several methods is known as triangulation research to researchers to increase validity (Ellram, 1996). Kovács and Spens (2007) maintained that inductive and deductive research approaches are mutual paths for advancing logistics knowledge, and should not be seen as competing, but supplementary approaches for logistics research. In addition, Näslund (2002) confirmed that "it is necessary to use both qualitative and quantitative methodologies of research, because we really want to develop and advance logistics research" (p.321). Easterby-Smith et al. (2002) classified the different types of triangulation into four forms as:

- Theoretical triangulation: using models from one discipline within another discipline.
- Data triangulation: the collection of data from different sources.
- Investigator triangulation: several researchers collect and analyse data.
- Methodological triangulation: using quantitative and qualitative methods of data collection.

The integration of qualitative and quantitative approaches within one study can lead to conflicting results from each paradigm. Even so most researchers thought that the integration of qualitative and quantitative methodologies would yield more important results when compared with using a single methodology, and would help researchers to avoid any trouble (Easterby-Smith et al., 2002; Mangan et al., 2004; Saunders et al., 2007). Furthermore, triangulation methods have been more accepted in recent times, because they help researchers to produce better research quality (Collis and Hussey, 2009; Saunders et al., 2007).

For this study, methodological triangulation was selected to validate and enhance the findings of the quantitative method (the method of Phase Two: a survey) with the qualitative method (the method of Phase One: semi-structured interview and method of Phase Three: structured interview). These three phases of methodology triangulation were employed to study and assess the relationship between SSCM

and SRES in Thai industry. From a philosophical perspective, this study will aggregate the information from pragmatism but it also combines the information from positivism and interpretisivism perspectives, rather than from one perspective only. Figure 3.4 explains more details from the three phases of triangulation methodology used in this study.

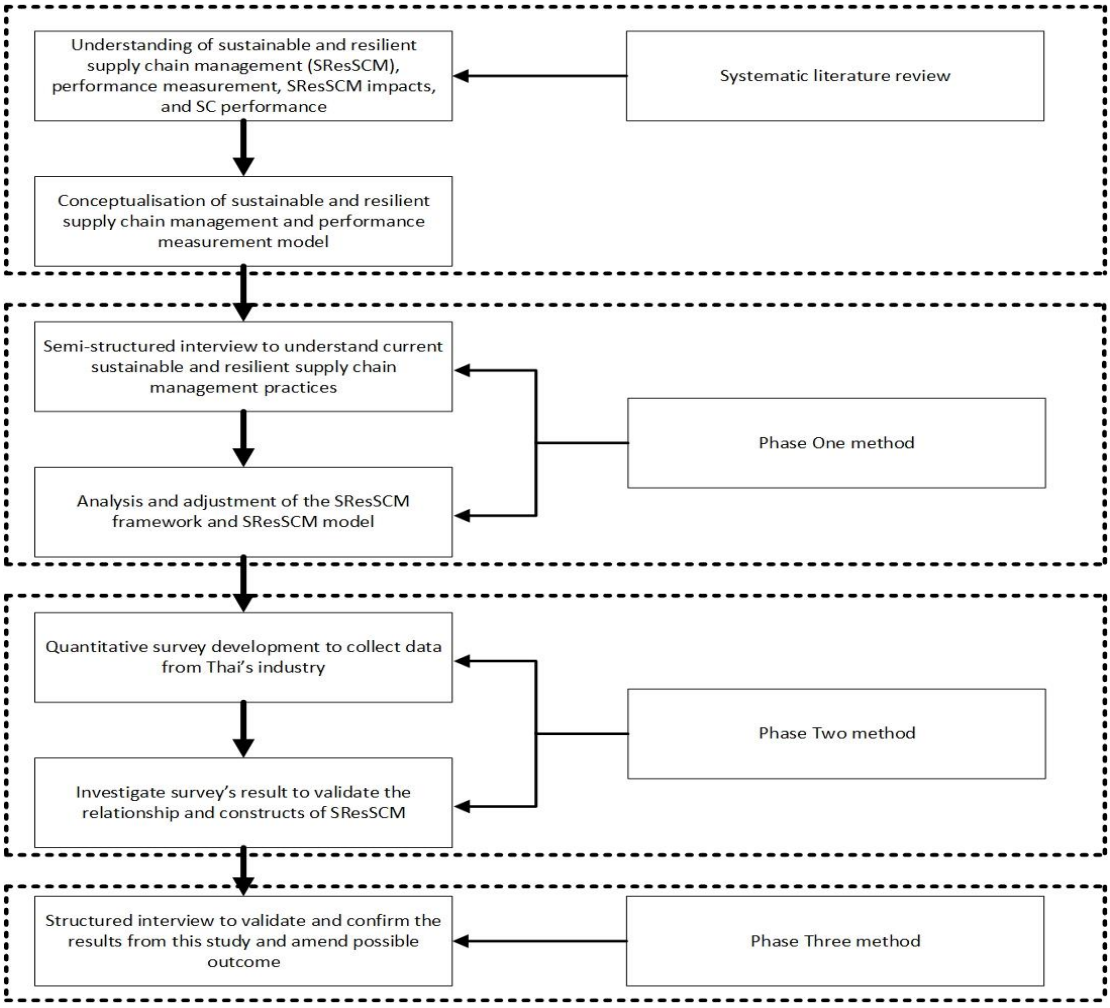

Figure 3.4: The research methodology for this study

3.3.2. Research approach

Easterby-Smith et al. (2008) noted lots of factors influence research design and that research philosophy is an essential factor affecting research collection and research analysis. Therefore, this factor influences the research strategies employed for all research studies. Research strategies can be classified according to philosophical

base, i.e. qualitative or quantitative methods, which involve different types of research design and strategy, as provided in Table 3.5.

Table 3.5: Research strategies used in the positivism and interpretivisim paradigms *(Sources:* Collis and Hussey (2009) and Mangan et al. (2004))

Positivism	Interpretivism
Cross-sectional studies	Hermeneutics
Experimental studies	Ethnography
Longitudinal studies	Participative enquiry
Surveys	Action research
Models and simulation	Case studies
	Grounded theory
	Feminist, gender, and ethnicity studies

Consequently, an overview of the research design for this study is presented in Figure 3.5. The selected design attempts to view the issues under consideration from variety of perspective. It combines the different methods and techniques, which come from both side, positivism and interpretisivim as the middle point, which is pragmatism. As mentioned above, the research design encompasses with three phases: 1) semi-structured interview, 2) a questionnaire survey and 3) structured interview. For each phase, it aims to address related to specified research questions of this thesis as presented in Figure 3.5.

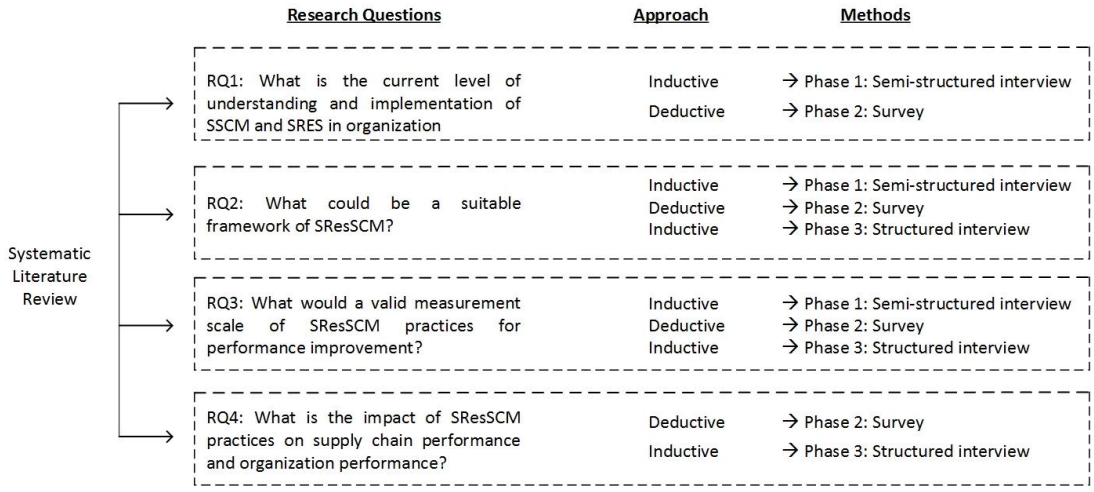

Figure 3.5: Overall research design

The semi-structured interview and survey with key informants will provide data to answer RQ1, which current understanding and level implementation of SSCM and SRES were focused. While, RQ2 is more qualitative in nature, it seeks to define a suitable framework of SResSCM. The researcher needs to define a clear definition of SResSCM by combining the definition of SSCM and SRES from existing literature and practitioners' perspectives together. So, semi-structured interview will help to develop a possible definition of SResSCM from the existing literature and the survey will test and define the relevant variables for SResSCM framework. Then, the researcher will validate and confirm the final definition of SResSCM from this study with a structured interview, which will be clear and provide opportunity to apply in organizations.

RQ3 for this thesis tends to be more quantitative in nature. It would like to study and define the valid measurement scale for the implementation level of SResSCM practices that organizations can use to measure their current practices and aware organizations for important SResSCM practices that organizations might implement next time. The number of survey data will help the researcher to answer this question and structured interview will help to confirm the research of this question as well. Finally, RQ4 of this thesis will be answered with the findings from survey and structured interview. This question requires a detailed analysis from survey result and validated again with a structured interview to ensure that these impact will emerged after implemented SResSCM concept in organizations by practitioners' point of view.

3.3.3. Scale development for this thesis

The main objective of the survey was to investigate the relationships between SSCM and SRES currently being used by suppliers-manufacturers-customers, and also develop measurement tools to measure the current level of SResSCM in each organization to enhance organizational performance and supply chain performance in the future. According to DeVellis (2012), measurement is of vital concern across a broad range of social research contexts, acquiring knowledge about people,

objects, events and processes by observing them. Making sense of these observations frequently requires that we quantify them (i.e. measure the things in which we have a scientific interest).

Normally, the measurement procedure used is the questionnaire and the variables of interest are part of a broader theoretical framework (DeVellis, 2012). Likewise, Likert (1932) made and developed a rating scale named the Likert scale to measure the statement of study. This Likert scale was applied in the survey for testing the conceptual model and hypotheses and to gain more understanding of the relationship between SSCM and SRES to provide the new definition as SResSCM. In measurement and scale development, there are two main aims: 1) to reduce measurement error by providing a more robust representation of complex variables and 2) to select the appropriate measurement items (Menor and Roth, 2007) which cover the construct domain with the desired reliability and validity.

To deal with these challenges, this study applied the scale development approach by Churchill (1979), DeVellis (2012) and Oppenheim (2000) as the main process, and combined this with appropriate steps from other researchers. New scales were developed for SResSCM due to the lack of existing survey items. DeVellis (2012) noted measurement in a broader research context, as shown in Figures 3.6 and 3.7. This study followed these steps to develop the measurement scale of SResSCM.

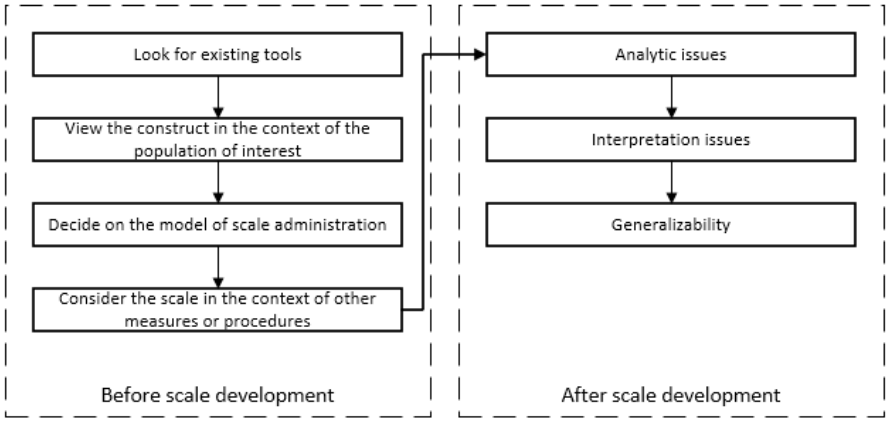

Figure 3.6: Steps of scale development *(Adapted from* DeVellis (2012), p.185-192*)*

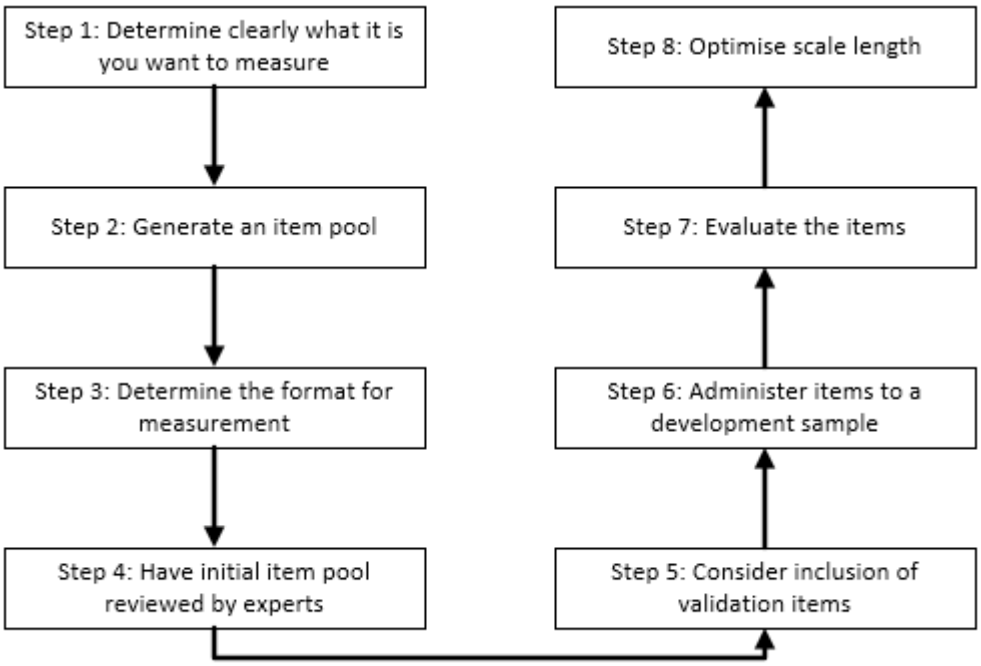

Figure 3.7: Guidelines for scale development *(Source:* DeVellis (2012), p.73-114*)*

According to Bryman and Bell (2011), the three most prominent criteria for the assessment of business and management are (1) reliability, (2) replication and (3) validity. Figure 3.8 illustrates scale development with validity, replication and reliability of quantitative and qualitative research. More details of these criteria follow.

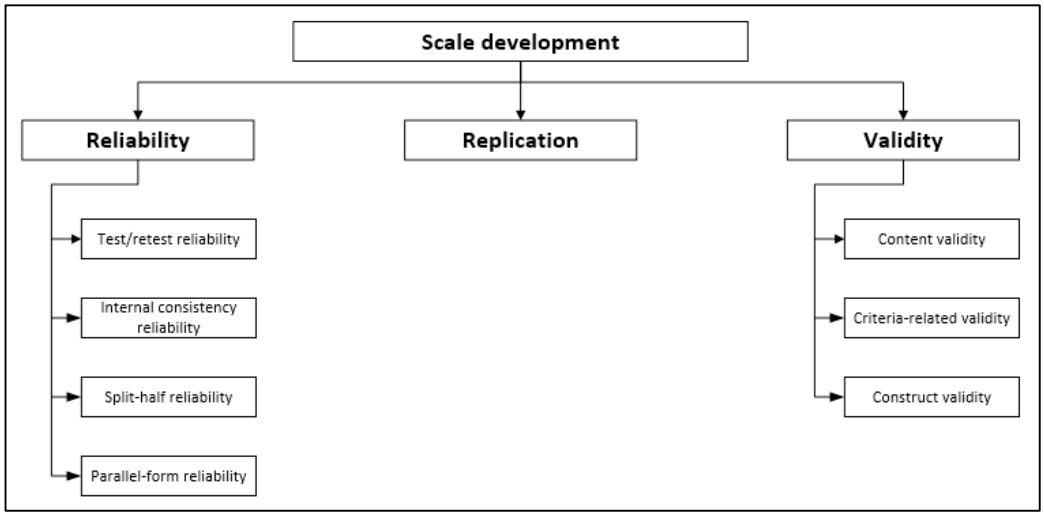

Figure 3.8: Scale development process *(Adapted from* Bryman and Bell (2011), DeVellis (2012), and Oppenheim (2000))

3.3.3.1 Reliability

Reliability is a fundamental issue in psychological measurement. Its importance is clear once its meaning is fully understood (DeVellis, 2012). Furthermore, Bryman and Bell (2011), explained that "reliability is concerned with the question of whether the results of a study are repeatable" (p.41). The term is normally used in relation to the question of whether or not the measures are advised for concepts in business and management. On the other hand, Oppenheim (2000) argued that reliability could be measured in various ways as: (1) repeating the scale with the same sample over a short period (test/re-test reliability); nevertheless, it will impact the results, as it cannot guarantee that the same test is under the same conditions. To prevent these problems the researchers can apply (2) the internal consistency method, which usually involves Chonbach's Alpha coefficient and its variants; or (3) the split-half method, or (4) the parallel-form method. These methods provide reliability measurements for different situations, however, the results might be the different but using the same content.

3.3.3.2 Validity

While reliability is concerned with how much a variable influences a set of items, validity is concerned about a variable's underlying cause of item covariation (DeVellis, 2012). As mentioned by Bryman and Bell (2011), "validity is concerned with the integrity of the conclusions that are generated from a piece of research" (p.42). Moreover, Oppenheim (2000) stated that "validity indicates the degree to which an instrument measures what it is supposed or intended to measure, but this is a somewhat vague statement especially since what we usually seek to measure is an abstraction, so that measurement must take place indirectly" (p.160). Different authors have different opinions on the main types of validity, for instance:

1) Bryman and Bell (2011) argued that there are four types of validity, named measurement validity, internal validity, external validity and ecological validity.
2) DeVellis (2012) stated that there are essentially three types of validity which correspond to these operations, known as content validity, criteria-related validity and construct validity.

3) Oppenheim (2000) cited a different validity coefficient for each item, including four types of validity: i) content validity, ii) concurrent validity, iii) predictive validity and iv) construct validity.

3.3.3.3 Replication

Bryman and Bell (2011) describe the idea of reliability as being quite similar to other criteria in business research, especially replication. Replicability normally shows cross-sectional research to the degree in which it is related to research procedures, i.e. selecting respondents; designing measures of concepts; administration of research instruments; and the analysis of data (Bryman and Bell, 2011). For measuring or assessing the reliability of concepts, the measurement or procedures should be replicable with some studies (Bryman and Bell, 2011). Therefore, it can be seen that replicability was an essential quality for the quantitative research used in Phase Two of this study. On the other hand, Halldórsson and Aastrup (2003) recommended that logistics researchers should consider the issues of truth-value, transferability and contextualism, trackability and explicitly when using qualitative approach. This had a bearing on the use of qualitative method in Phase One and Phase Three of this study.

Accordingly, for this study, the processes of scale development were applied from Churchill (1979), DeVellis (2012) and Oppenheim (2000) to enhance the validity and reliability of new scale, as shown in Figure 3.9.

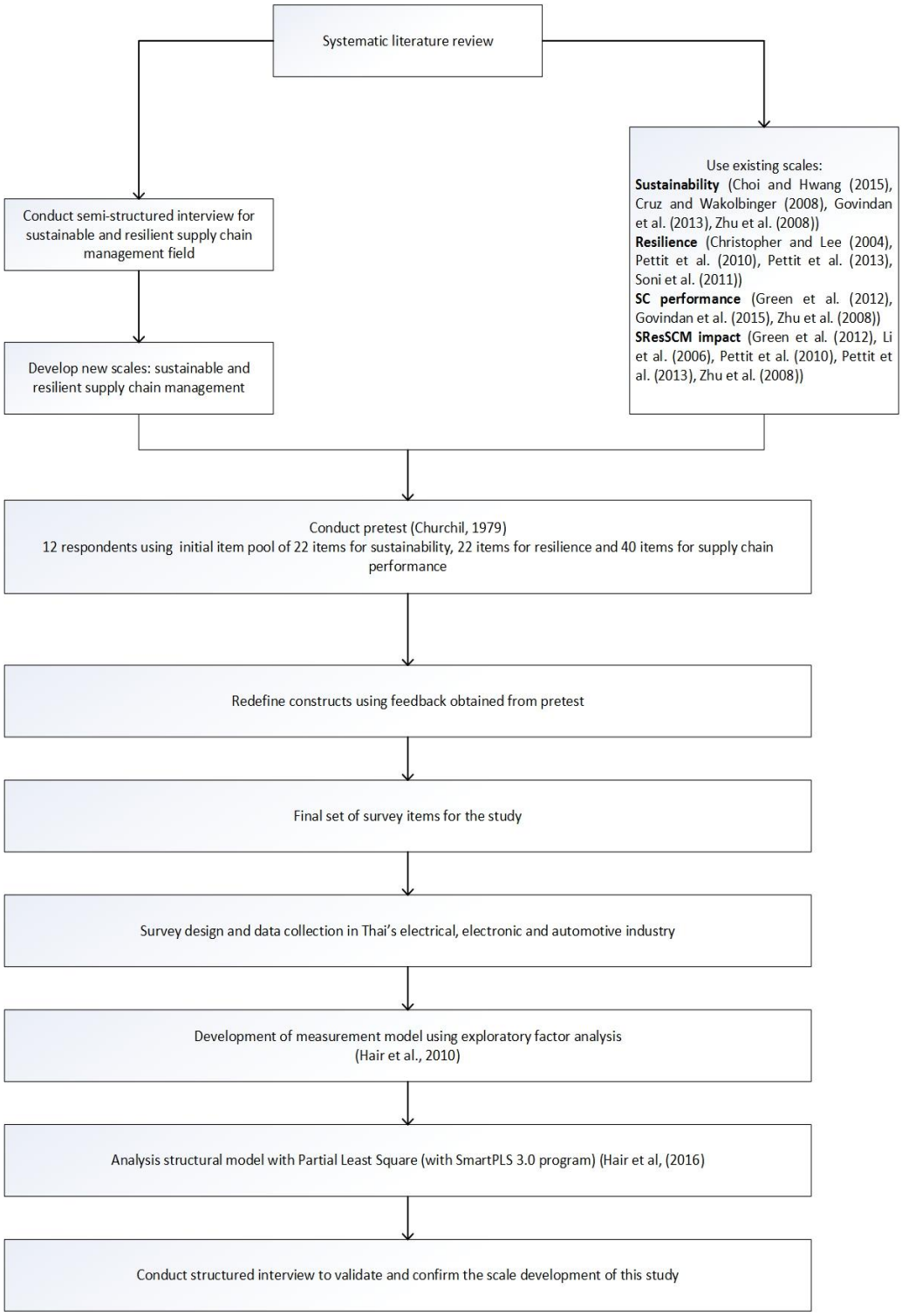

Figure 3.9: Scale development for this study *(Adopted from Churchill (1979), DeVellis (2012), and Oppenheim (2000))*

As presented in Figure 3.9, these steps represent scale development for this study. According to Chapter 2 of this thesis, it can be found that there are some existing scales from previous studies, for instance, for SSCM field Choi and Hwang (2015),

Cruz and Wakolbinger (2008), Govindan et al. (2013), Zhu et al. (2008); for SRES field Christopher and Lee (2004), Pettit et al. (2010), Pettit et al. (2013), Soni et al. (2011); for SC performance Green et al. (2012), Govindan et al. (2015), Zhu et al. (2008); and for SResSCM impact Green et al. (2012), Li et al. (2006), Pettit et al. (2010), Pettit et al. (2013), Zhu et al. (2008). These existing scales were integrated and modified with the findings from Phase One: semi-structured interview (see Chapter 4) to develop a new scale for the SResSCM field.

This initial SResSCM scale was pre-tested before collecting data with the main survey. Then, the questionnaire was ready to collect data from Thailand's industry and was sent out to the sample group. The data collected were a combination of text and numerical responses to the online survey. Statistical significance was studied for development of the measurement model by using exploratory factor analysis (Hair et al., 2010) and the structural model by using Partial Least Squares analysis (Hair et al., 2016) (see Chapter 5). Lastly, the findings from Chapter 4 and 5 were validated and confirmed with practitioners from Thailand's industry (see Chapter 6). The final development of the SResSCM scale is discussed in Chapter 7 and concluded in Chapter 8 of this thesis. Consequently, although the research is primarily exploratory, the combination of interviews and survey research will support extending the data collection of this thesis. Research methods for each phase are discussed in the next section.

3.4 Phase One: Semi-structured interviews

In data collection, the term qualitative is used for non-numeric data gathering techniques, such as interviews, while quantitative is used as a synonym for numeric data, for instance, that gathered in a questionnaire survey (Bryman and Bell, 2011). As mentioned by Burgess (1982), "the interview is the opportunity for the researcher to probe deeply to uncover new clues, open up new dimensions of a problem and to secure vivid, accurate inclusive accounts that are based on personal experience". Moreover, Easterby-Smith et al. (2012) noted that most interviews are conducted on a one-to-one basis, between the researchers and the participants.

Interviews can be highly formalized and structured or semi-structured or unstructured, as demonstrated in Table 3.6. The latter, are both appropriate interview methods when (Easterby-Smith et al., 2012):

1. The respondents understand the constructs, which are used to review the opinions about a particular matter or situation.
2. The purpose of the interview is to review and develop respondents' understanding independently or collaboratively in cases with action research by the researchers.
3. There are some issues that are highly confidential or commercially sensitive for which step-by-step logic is used rather than a one-to-one interview situation.

Table 3.6: Types of interview *(Source:* Easterby-Smith et al. (2012), p.128*)*

Level of structure	Type of interview
Highly structured	Market research interview
Semi-structured	Guided open interview
Unstructured	Ethnography

Bryman and Bell (2011) defined a semi-structured interview as "a context in which the interviewer has a series of questions that are in the general form of an interview schedule but it able to vary the sequence of questions" (p.205); while they provide aim of structured interview as "all interviewees to be given exactly the same context of questioning" (p.202). Moreover, Saunders et al. (2007) provide some reasons to use non-standardized research as a method, which related into four aspects such as "1) the purpose of the research; 2) the significance of establishing personal contact; 3) the nature of the data collection questions; and 4) length of time required and completeness of the process" (p.323). Furthermore, Saunders et al. (2007) also advise that "semi-structured interview and in-depth interviews provide you with the opportunity to probe answers, where you what your interviewees to explain, or build on, their responses" (p.324).

For Phase One, SResSCM variables and definition were defined, analysed and developed through semi-structured interview. Meanwhile, Phase Three was conducted with a structured interview to validate the findings from Phase One and Two. According to the purpose of Phase One being to review the variables of SResSCM in the context of Thailand's industry, semi-structured interview is chosen as an approach for this phase. Therefore, it can be seen that a semi-structured interview suitable for a beginning of this collection research and a structured interview more suitable for validate and confirm the results of this thesis.

3.4.1. Semi-structured interview protocol development

The interview protocol development for Phase One related to the literature review of this study where the researcher used information from previous studies to develop variables. According to a priori expectations for Phase One, the researcher developed questions related to SResSCM practices. SSCM and SRES constructs in the literature were selected to help the researcher to achieve the research objectives and answer the research questions for this study. The steps taken in formulating questions for an interview guide in the qualitative research are presented in Figure 3.10.

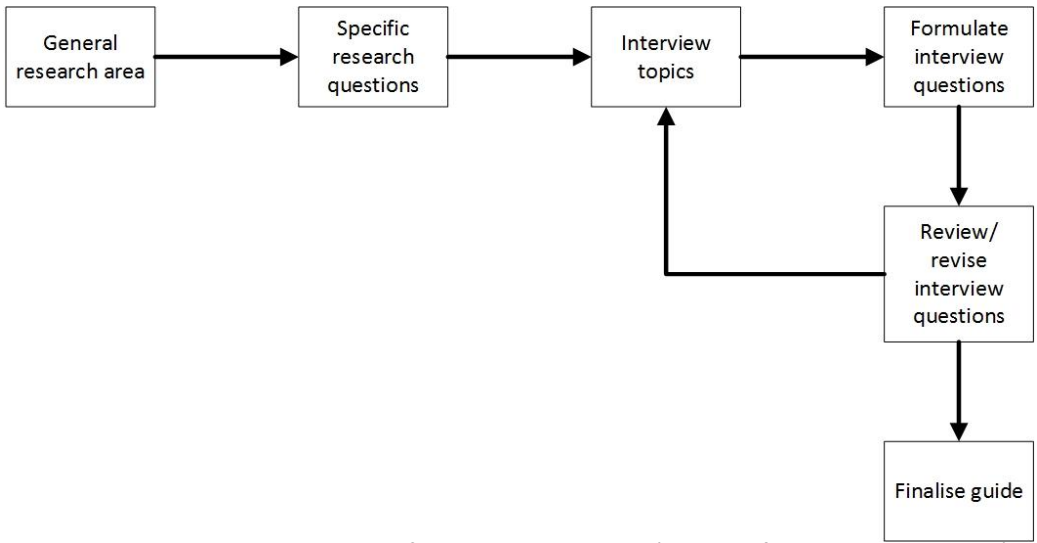

Figure 3.10: Formulating questions for an interview guide *(Adapted from* Bryman and Bell (2011), p.477*)*

The interview protocol was developed from the existing literature and t reviewed and developed with the researcher's supervisors. The key issues for semi-structured interviews are to: define the understanding in SSCM and SRES from practitioners' perspective; study the relationship between SSCM and SRES in organizations; confirm variables of SSCM and SRES; and study the process of performance measurement in organizations. Following stages one to five, the finalized interview questions for semi-structured interviews were ready to use to collect the data from the practitioners. According to these processes, the interview protocol for semi-structured interview was generated as shown in Appendix A.

3.4.2. Qualitative sampling

The whole set of eligible entities for whom research can be conducted is known as the population (Easterby-Smith et al., 2012). The sample is the group of the population that is selected for study (Bryman, 2008). On the other hand, the sample frame is the members' list for the population from the selected sample. Sampling techniques can be classified into two groups: probability and non-probability sampling (Saunders et al., 2007). According to Bryman and Bell (2011), probability sample is "a sample that has been selected using random selection so that each unit in the population has a known chance of being selected" (p.176). The probability sampling techniques are stated in Table 3.7.

Table 3.7: Probability sampling techniques *(Source:* Easterby-Smith et al. (2012), p.226-227*)*

Probability sampling techniques	Details	Advantages
Simple random sampling	Every sample entity has an equal chance of being part of the sample	Easy to draw up a list of random numbers as a basis for selecting a sample
Stratified random sampling	Divide the population into small groups and then take a simple random sample within each group	Small (advantage) but important parts of the population are missed altogether (disadvantage)
Systematic random sampling	Generate a list in some form or other of the units in the population that the researcher is interested in	The list is essentially organized randomly, so that bias is not introduced
Cluster sampling	Divide the population into clusters then sample all units from within the selected cluster	The study allows the use of local research staff who are familiar with the language and culture of each country
Multi-stage sampling	Combine together the methods described above in order to achieve higher operational and technical efficiency	To balance the need for representativeness of the sample with the highest possible cost effectiveness

On the other hand, non-probability sample is "a sample that has not been selected using a random selection method. Essentially this implies that some units in the population are more likely to be selected than others" (p.176) (Bryman and Bell, 2011). The non-probability sampling techniques are explained in Table 3.8.

Table 3.8: Non-probability sampling techniques *(Source:* Easterby-Smith et al. (2012), p.228-229*)*

Probability sampling techniques	Details	Advantages
Convenience sampling	Selecting sample units on the basis of how easily accessible they are	Very common and convenient
Quota sampling	Divide the relevant population up into category and then selection continues until a sample of a specific size is achieved within each categories	Sampling can be controlled for certain characteristics
Purposive sampling	The researcher has a clear idea of what sample units are needed, and then approaches potential sample members to check whether they meet eligibility criteria	Reasonable control over sample content
Snowball sampling	A form of convenient sample but with this method, the researcher was able to make initial contact with a small group of people relevant to the research topic and use these to make contact with others	Suitable for samples where individuals vary and it is difficult to identify who belongs to the population

The main objectives of the qualitative semi-structured interviews were to focus on the items in each construct of SResSCM practices model drawn from the literature

by eliminating irrelevant items and confirm the main factors that affect SResSCM implementation. The sample frame for the Phase One study comprised members of the Thai electrical and electronic industry. The sampling was initiated using convenience sampling as the researcher contacted ex-colleagues who work in Logistics Departments in the electronic industry. Subsequently, the other eight participants for the semi-structured interviews were selected using a snowball technique based on personal advice from the ex-colleagues as well as the reputation of the companies in electrical and electronic industry. As Easterby-Smith et al. (2012) explain the snowball technique "starts with someone who meets the criteria for inclusion in a study who is then asked to name others who would also be eligible" (p.229). The demographics of the interview participants are discussed in more detail in Chapter Four. Thus, some participants in Phase One came from the researcher's ex-colleagues, and they provided suggestions for the remaining participants. However, Bryman and Bell (2011) stated the problem with a snowball is "it is very unlikely that the sample will be representative of the population, though, as we have just suggested, the very notion of a population may be problematic in some circumstances" (p.193). Consequently, the researcher needed to review and select appropriate interviewees from ex-colleagues' suggestion because sometimes snowball sampling might used to contact to people or groups not in the sampling frame (Bryman and Bell, 2011). Accordingly, six companies with nine practitioners were used and due to the small size of the sample, it was suitable to conduct in-depth interviews for about two hours. The results from the semi-structured interview provided rich data to develop and enhance SResSCM definition and practices.

3.4.3. Data collection and data analysis

According to Bryman (2008), semi-structured interview is interview using an interview guide that contains a list of questions on reasonably familiar topics. After the researcher had prepared the interview protocol with his supervisors, appointments with all participants were made by email or telephone. The semi-structured interview section was conducted between October and November 2015

in Thailand. The participants received the questions by email in both English and Thai versions, because the interview sections took place in Thailand, where Thai was the main language.

Phase One consisted of four steps of data collection as: 1) prepare an interview protocol; 2) snowball sampling and make interview appointments; 3) conduct tape-recorded interviews; 4) transcript, coding and analysis, as presented in Figure 3.11.

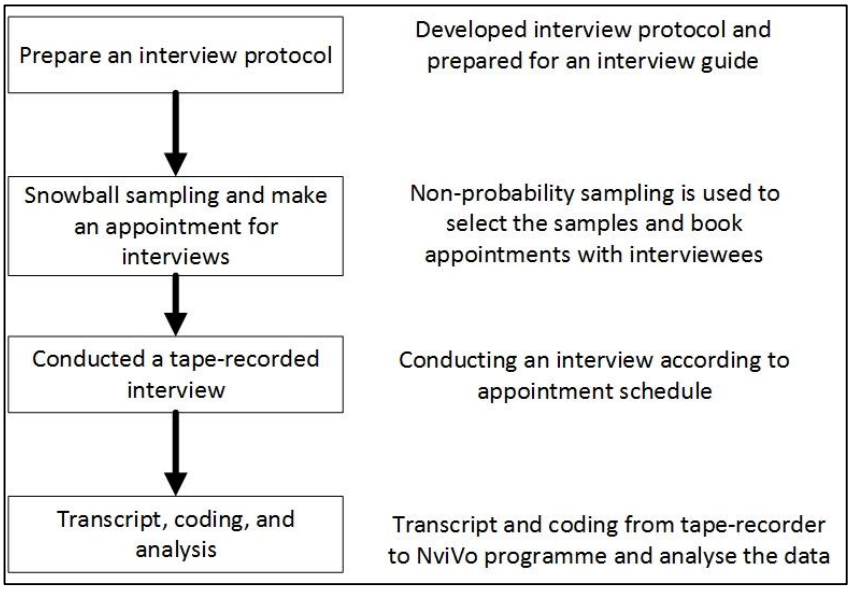

Figure 3.11: Data collection processes in Phase One *(Adapted from Churchill and Iacobucci (2010))*

As mentioned above this thesis applied snowball sampling for Phase One, as well as for Phase Three; however this technique has limitations as it is difficult to identify populations (Saunders et al., 2007). Thus, the researcher had to ensure all interviewees in Phase One and Phase Three are members of the population. Although Phase One of this thesis has only nine interviewees they provided fairly rich data and also have significant experiences in their work. Therefore, the researcher considers findings from these interviewees contain reliable information. Moreover, most of them also provided the concept of SSCM and SRES at the same direction and their suggestions are rich data for confirming the variables of SSCM and SRES in the context of Thailand. Thus, Phase One would have provided some insightful for developing the questionnaire for a survey in Phase Two of this study.

For the qualitative study in this thesis, content analysis was applied in Phase One and Phase Three after insert transcript documents in to NviVo program. The researcher used NviVo program to group the answer from each interviewee for each question together and then the researcher analysis the data manually. According to Bryman and Bell (2011), they defined content analysis is "an approach to the analysis of documents and texts that seeks to quantify content in terms of predetermined categories and in a systematic and replicable manner" (p.289).

3.5 Phase Two: Survey

For Phase Two, the survey was also conducted in the Thai industry, using all supply chain members, i.e. as suppliers – manufacturers – customers. As mentioned above, the survey aimed to investigate the operations of supply chain in Thai industry, from manufacturers to suppliers and their customers so that SResSCM could be acquired. Consequently, the concepts of improving SResSCM in terms of manufacturing and their supply chain aspects were developed. Moreover, in this survey, the relationship between SSCM and SRES was conducted and validated, derived from semi-structured interview (Phase One) and the survey (Phase Two). It was conducted as a means to further validate and generalize the derived improvement issues.

Regarding to a semi-structured interview in Phase One, the findings as presented in Chapter 4, used to develop as a questionnaire survey for collecting with a large number of sample size as Thailand's industry, i.e. electrical, electronic and automotive industry. It can be seen that the findings from Phase One help the researcher to develop the scale to measure 1) the relationship between SSCM and SRES in practitioners' perspectives, 2) the implementation level of SResSCM practices in organizations, 3) the improvement of supply chain performance once organizations implemented SResSCM practices successfully, and 4) the impact from SResSCM practices on organizations performance in short and long-term impact. With Phase One findings, it was integrated with the scale in the existing literature review as presented in Figure 3.9. As mentioned above this thesis needs to test

statistical significance on a larger population of practitioners to build theory and generalize the findings, so the aim of Phase Two is to obtain information from population of this thesis and then analysis with statistic significance, which is a traditional methodology tool associated with logistics research.

This section begins with the selection of sample, survey instrument, non-response bias, translation and back-translation, questionnaire development, data collection, statistical analysis of results and SEM approach, respectively.

3.5.1. Selection of sample

The sample for the survey encompassed all actors in the supply chains as Original Equipment Manufacturers (OEMs), and their suppliers and customers in the Thai industry. The lists of electrical and electronic organizations were obtained from the websites of The Federation of Thai Industries (FTI), Department of Industrial works (DIW), Electrical and Electronics Institute (Thai EEI) and Industrial Estate Authority of Thailand (IEAT), respectively. By the way, the lists of automotive organizations were from the Department of International Trade Promotion (Ministry of Commerce, Thailand), Industrial Estate Authority of Thailand, Thai Auto Parts Manufacturers Association (TAPMA), The Thai Automotive Industry Association (TAIA) and the Federation of Thai Industries. The organizations from these websites were selected and compared within an Excel file due to there being some duplicate information from each website.

Probability sampling technique is generally used in quantitative research (Bryman and Bell, 2011). Table 3.7 (Section 3.4.2) shows the different types of probability techniques and advantages. There are five kinds of sampling techniques that can be used to select the sampling, namely: simple random sample (SRS), stratified random sampling, systematic random sample, cluster sampling and multi-stage sampling (Easterby-Smith et al., 2012).

Regarding to Table 3.9, this thesis used simple random sampling for the population in Phase Two using Thai industry databases. There are around 3,896 organizations contained in those databases in the electrical, electronic and automotive industry sectors. The researcher manually checked and tried to make contact with all these organizations, however around 2,633 were either not interested in participating or did not respond to e-mail and telephone requests. Thus, the total sample frame for this thesis is only 1,263 organizations. The researcher sent out the questionnaire on-line by email to the sampling frame. Accordingly, an overall response rate for this thesis was approximately nine percent (113 usable from 1,263 sampling).

3.5.2. Survey instrument

This section explained different means of data collection for the mail survey conducted. According to Bryman and Bell (2011), there are various types of survey process, such as a structured interview schedule or a self-completion questionnaire, as shown in Figure 3.12. The survey instrument was developed based on the systematic literature review and the findings from Phase One: semi-structured interview. Before the survey was considered in its final stage, it was also pre-tested by 12 experts in organizations from the electrical and electronic industry in Thailand.

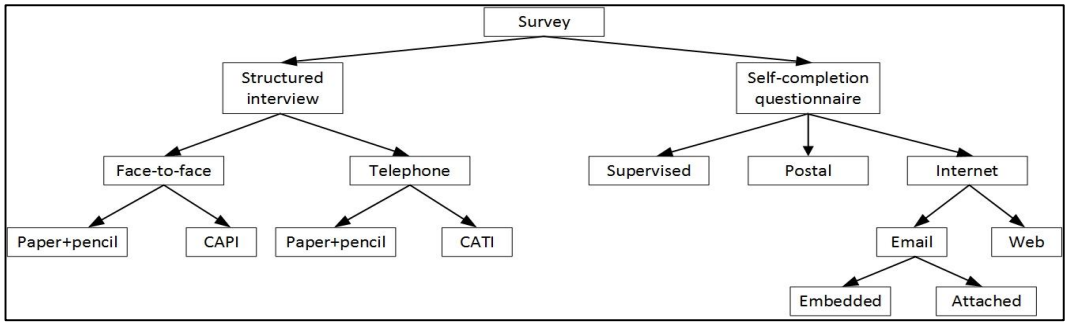

Figure 3.12:Main modes of administration of a survey *(Source:* Bryman and Bell (2011), p.175*)*

The final survey instrument using a 5-point Likert scale (see Appendix B, Section B, which has six scales that encompass “Do not know” to give more choice to respondents) consisted of eight key constructs, including the sustainability side as ECO-Design, green production, social responsibility, investment recovery, and

resilience side as collaboration, recovery, external pressure and connectivity. The goal was to determine the relationship between SSCM and SRES according to these variables. Moreover, these variables were used to validate the performance measurement and impacts of SResSCM as the aims of this study.

3.5.3. Questionnaire development

Reliability and validity of the data were measured according to a scale development from Chapter Three and Four. The questionnaire was carefully designed using a nine-step procedure as mentioned by Churchill (1979). The systematic approach would also ensure the proficient utilization of data collection. The approach comprised nine steps, as follows:

1) Develop the questionnaire protocols for SResSCM practices: after review using a systematic literature review and findings from semi-structured interviews (Phase One), the questionnaire protocols were developed and translated into the Thai language by the researcher and translators 1 & 2. For this study, a Likert (1932) scale was applied as the rating method. Respondents would rate scale with their opinion, from strongly disagree to strongly agree. This scale is appropriate for this study because it provides an interval or ratio base (Likert, 1932), which is a well-known scale for statistical analysis (Hair et al., 2010).

2) Re-examination and revision for questionnaire survey: once the questionnaire was designed, there were some points to revise. The revised questionnaire was processed with the researcher and his supervisors in order to investigate for any errors. This process also helped to foresee any potential problems. Errors and ambiguity should be minimized or eliminated at this stage.

3) Back-translation process: according to reliability and validity, the questionnaire protocols in the Thai version were back-translated into the English version to cross-check the definitions and contents in both versions. The modified questionnaire was carried out from this step.

4) Pre-test survey: after the questionnaire appeared as two versions, in English and Thai, it was distributed to participants for a pre-test survey. Feedback

and comments were returned within three weeks to the researcher for reviewing and amending the questionnaire before distributing the main survey. Reliability of pre-test data was assessed by comparing with Cronbach's alpha (Cronbach, 1951).

5) Finalize the questionnaire protocols: after the pre-test process, the final questionnaire was developed for SResSCM practices in terms of performance measurement and SResSCM impacts. Both versions, English and Thai, were prepared as Microsoft Word files and on-line survey for the main survey.

6) Questionnaire distribution: the respondents came from within Thai industry, and received the questionnaire via mail survey. Respondents could complete the questionnaire via on-line survey (as links in the email) or in Microsoft Word, and then return the completed questionnaire to the researcher. In the email, the researcher attached a cover letter from Bangkok University, Thailand as a sponsor, together with a letter from the researcher who conducted this study.

7) Follow-up and reminder: respondents received an email to remind them their questionnaire was due for return two weeks before the deadline. However, an additional period of time was allowed for respondents requiring more time, in order to increase the response rate.

8) Gathering the questionnaires and coding: there were two different types of survey in this study, on-line survey and attached files survey. The results from these two types were transferred, coded and prepared for analyzing with IBM SPSS statistics 23.

9) Data analysis: the findings from the questionnaire were analysed with statistical analysis as means, standard deviation, factor analysis, by IBM SPSS statistics 23 and structural equation modelling (SEM) to test the hypotheses of this study by Smart PLS 3.0 programme.

According to the following questionnaire development, the questionnaire protocol was completed as shown in Appendix B.

3.5.4. Non response bias

None-response bias means “bias in findings caused by respondent refusing to take part in the research or answer a question” (p.596) (Saunders et al., 2007). In addition, Oppenheim (2000) argued that “the issue concerns not the number or proportion of non-respondents, but the possibility of bias” (p.106). However, to obtain a high survey response rate and decrease non-response bias, the researcher called the respondents via telephone to verify from who was willing to participate in this study. Moreover, about two weeks before the deadline, the researcher sent a reminder email, thanking those who had already responded and reminding those who had not yet returned the survey.

3.5.5. Translation and back-translation

The questionnaire was initially generated in the English language. However, organizations in Thai manufacturing normally use Thai language, so the questionnaire had to be translated from English into Thai. Douglas and Craig (2007) explained that researchers need to apply a collaborative and iterative translation approach to ensure conceptual equivalence. A cross-cultural translation questionnaire was required for this study; so two experts were employed as translators, one to gain an academic perspective from one of the top universities in Thailand, and another expert from an organization in Thailand. Both experts translated the questionnaire into Thai language independently. The researcher then combined these versions together. They subsequently reviewed and approved the Thai questionnaire version for executing back-translation as the next step.

After that, back-translation was applied to this study as well. The researcher initially planned to employ two experts, one in academia and another from an electronic company, but as this process took place during the last month of the business quarter, most practitioners/experts were very busy. Therefore the researcher used two bilingual translators, who had graduated in the UK and worked in multi-national companies in Thailand, to do the back-translation. Details of the translators and back-translators are presented in Table 3.9. The processes of the

corporation translation and back-translation of the questionnaire are presented in Figure 3.13.

Table 3.9: Details of translators and back-translators for Phase Two

Types	Detail of translator	Academic degree
Translator 1	Associate Professor in Operation management department from Kasetsart University, Thailand	PhD in industrial management at the Graduate School of Clemson University, USA
Translator 2	Staff production planner from multi-national electronic company, Thailand	BAs Political Science at Ramkhamhaeng University, Thailand
Back-translator 1	Customer service tracing advisor from multi-national transportation company, Thailand	MSc Logistics management at the University of Hull, UK
Back-translator 2	The economist, macroeconomics and forecast division at Bank of Thailand	MSc International Finance and Economic Development, University of Kent, UK

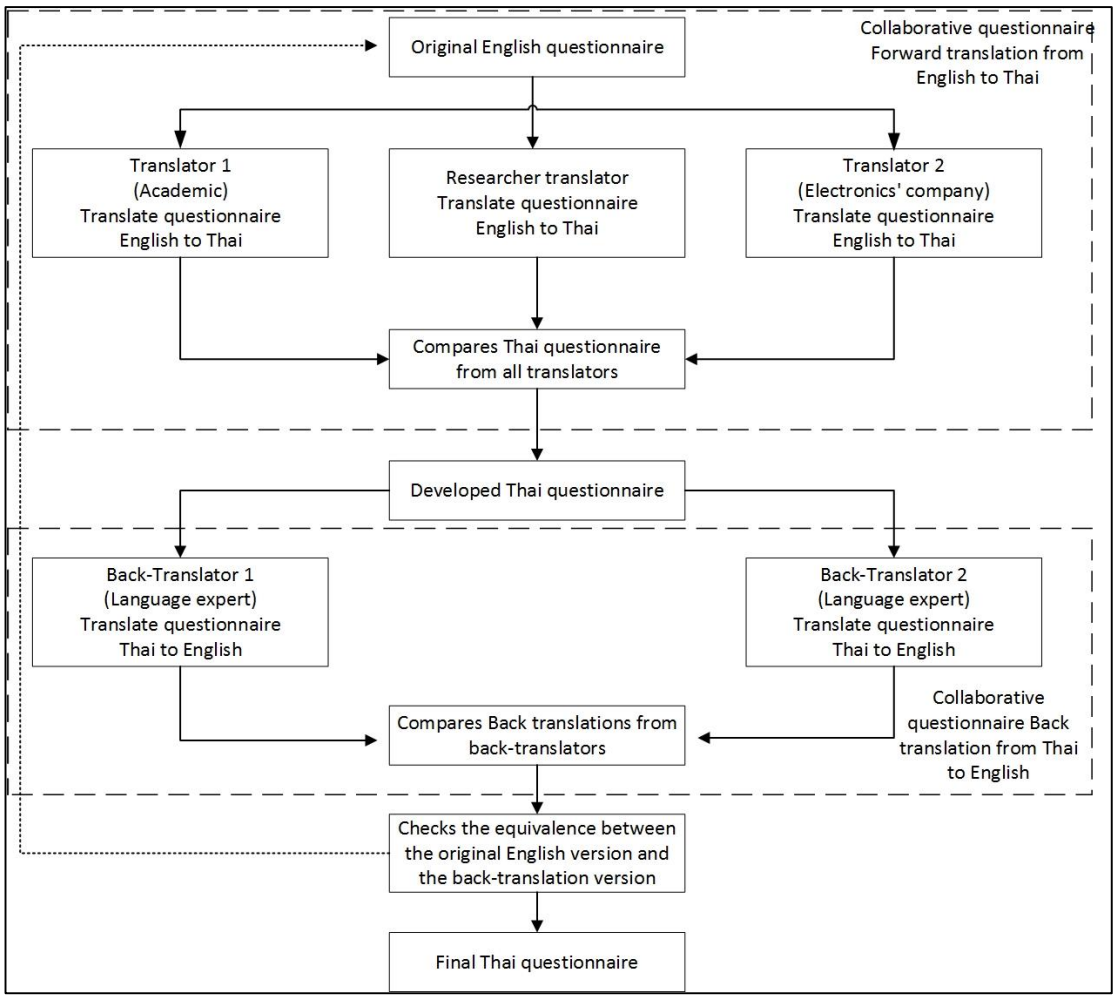

Figure 3.13: The process of collaborative translation of the questionnaire *(Adapted from Douglas and Craig (2007))*

3.5.6. Data collection

This section explains the processes of data collection from Phase Two. The period of time to collect the pre-test was from 13th – 31st March 2016, and the main survey was from 19th April 2016 – 31st July 2016. The details of these processes were:

a. Pre-test study

To test the questionnaire before use in the main survey, emails introducing the study were distributed to members of Thailand's electrical and electronic industry and distributors, amounting to around 18 participants, as shown in Table 3.10. The respondents answered with their understanding and opinions from their

organizations relating to SResSCM practices and the relationship between SSCM and SRES. In total, 12 responses were received and analysed in the pre-test stage.

Table 3.10: Details of pre-test respondents in Phase Two

No.	Details of pre-test respondents	Position in SCs
Pre-1	Logistics manager from semiconductors company	1st Tier Supplier
Pre-2	Production Control manager from semiconductors company	1st Tier Customer
Pre-3	Product planning manager from air-conditioning company	Focal firm
Pre-4	Operation manager from worldwide 3PLs	Distributors
Pre-5	Operation manager from electronic appliance company	1st Tier Supplier
Pre-6	Managing director from integrated circuits company	3rd Supplier
Pre-7	Logistics manager from semiconductors company	1st Tier Supplier
Pre-8	Supply chain development from worldwide 3PLs	Distributors
Pre-9	Key accounts manager from Japanese 3PLs	Distributors
Pre-10	Supply chain senior from semiconductors company	3rd Supplier
Pre-11	Supply chain director from generator company	Focal firm
Pre-12	Quotation from harddisk product company	Focal firm

Regarding to the results of pre-test study, the Cronbach's Alpha is greater than 0.70, which indicate adequate reliability of the measurement scale. So the researcher concluded that the questionnaire was reviewed the data and the researcher did not find any obvious error or anything that invalid the question. However, there are some comments from respondents that the researcher needs to review and revise wordings in questionnaire for better explanation in the main survey. For example, the researcher changed the question description as "Environmental concerns influence the design of products/processes in the company "to "The company adopted environmental concerns when designing their products/processes" or "Decreased in fine for environmental accidents "to "The company can decrease expenses for environmental accidents" so on and so forth.

b. Main study

During the main study, the questionnaires were distributed to around 2,500 organizations via email with attached questionnaire files and links to complete an online survey, to increase the internal and external validity of the data obtained from the survey (Grant, 2005). Researcher followed Oppenheim (2000)

recommendations to increase the response rates for email surveys as: advance warning, explanation of selection, confidentiality and reminders. This is because most survey studies tend to have a low response rate (usually less than 20%).

3.5.7. Statistical analysis of results

The objectives of this survey were to 1) study the relationship between SSCM and SRES, 2) investigate short and long-term impacts of SResSCM and 3) develop performance measurement for SResSCM practices with supply chain performance and organization performance. The results from this survey using semi-structured interviews (Phase One) and structured interviews (Phase Three) were accordingly acquired. This would lead to the development of the concept of SResSCM and enhanced measurement tools to assess SResSCM practices and provide further improvement to organizations in the future. Moreover, this survey also validated SResSCM variables within Thai industry. The methods used included descriptive statistical analysis, means, standard deviation and analysis of variance. All methods of analysis were made by using the IBM SPSS statistics 23.

- Assessing measurement quality

Bryman and Bell (2011) argued that "the quality of measures is mainly evaluated in terms of reliability and validity. Reliability is concerned with stability and consistency in measurement, while validity is concerned with whether we are measuring the right concept" (p.61). As stated in Section 3.3.3, the reliability and validity of this study were measured, and factor analysis was applied to evaluate construct validity. The most popular test within the internal consistency method is "the Cronbach coefficient alpha" (Cronbach, 1951), so Cronbach's alpha was applied to validate reliability for this survey.

- Descriptive statistical analysis

The survey was analysed using descriptive statistical analysis as frequency, means and standard deviation to classify various types of sample and various points from the answers to each question. This analysis mentioned the quantities and

frequencies of a particular variable from the sample, so that the level of importance of such variables on the constructs being studied could be acknowledged.

- Factor analysis

Factor analysis was used in this study. Hair et al. (2010) stated that "factor analysis is an interdependence technique whose primary purpose is to define the underlying structure among the variables in the analysis" (p.92). For this study, exploratory factor analysis was selected for Phase Two to identify the relationship between the variables.

3.5.8. Structural equation modelling (SEM) approach

Structural equation modelling (SEM) is "multivariate technique combining aspects of factor analysis and multiple regression that enables the researcher to simultaneously examine a series of interrelated dependence relationships among the measured variables and latent constructs as well as between several latent constructs" (p.546) (Hair et al., 2010). Consequently, SEM model encompasses two main parts: i) measurement model and ii) latent variable model (Fox, 2006; Jőreskog and Thiilo, 1972). Firstly, the measurement models are set to validate the latent constructs and their measurement items (Iacobucci, 2009). Secondly, the latent variable model, often called the structural model, is used to evaluate the causal relationships between the latent variables in the measurement model (Hair et al., 2010). The role of the structural model is for testing the hypotheses (Iacobucci, 2009). SEM technique uses regression and covariance analysis to scrutinize a relationship between latent constructs (Hair et al., 2010). The important output from SEM is the statistically proven theoretical model that has an advantage over linear regression analysis in terms of SEM, allowing more than one relationship in the model, whereas linear regression can deal with one relationship only (Hair et al., 2010). Consequently, these techniques were applied for studying the relationships between SResSCM variables. Therefore, SEM was used to determine the validity, reliability and relationships amongst remaining

variables and latent constructs, which are SSCM, SRES, SResSCM, SC performance and SResSCM impact variables and used to test hypotheses of this study.

3.6 Phase Three: Structured interview

Phase Three indicated the last phase of the research design of methodological triangulation process for this study. The main purpose of Phase Three was to validate and confirm the research findings, based on Phase One and Phase Two results to support improvement of the reliability and validity of the overall research, and investigate the definition of SResSCM from the practitioner's perspective. Questions in structured interview are very specific and very often offer the participant a fixed range of answers (Bryman and Bell, 2011). Moreover, the structured interview is the typical form of interview in social survey research (Bryman and Bell, 2011). Therefore, a structured interview is selected for this phase because the aim of a structured interview is "to ensure that interviewees' replies can be aggregated and this can be achieved reliably only if those replies are in response to identical cues" (p.202) (Bryman and Bell, 2011). Therefore, this phase supports to improve the validity and reliability of the overall research findings. Phase Three encompassed two main steps: 1) the methods and techniques of structured interview protocol and 2) data collection and data analysis.

The structured interview was conducted in December 2016, and involved the participants from Phase One and newcomers who were interested in the topic of SResSCM. All participants received the same information from the researcher about SResSCM practices and definition. The researcher set the interview in a comfortable place that participants preferred within their organization or elsewhere. The structured interview including each section took about 60–90 minutes to ensure that the results from Phase Three could be fully analysed and interpreted from this section. According to the findings from Phase One and Phase Two, the results of this thesis was validated and confirmed in Phase Three to increase the reliability and accuracy of this thesis, to reduce errors due to variability and to ease of data processing of overall research. In Phase Three, the final definition of SResSCM,

SResSCM practices variables, SC performance variables, and SResSCM impacts were summarized.

3.6.1. Structured interview protocol

Phase Three validated the findings from Phase One and Phase Two with the structured interview. The questions were developed from previous stages, then the findings were analysed and summarized to fulfil the research questions according to the research objectives for this study. As mentioned by Bryman and Bell (2011) in Figure 3.12, a research instrument simply means something like a structured interview schedule or a self-completion questionnaire**.** However, there are some differences between structured interview and self-completion questionnaire, such as cost of surveys, time period for collection, risk of missing the data, or convenience of respondents (Bryman and Bell, 2011). This phase explained in more detail the structured interview applied in this study. During the structured interview section, the researcher recorded the conversation between participants and researcher, with permission from all participants in order to protect against misunderstanding and reduce error due to interviewer variability. A structured interview was applied to validate the results from a questionnaire survey by comparing the results from Phase One and Phase Two, which were represented the support and arguments among the perception of Thailand's industry.

The questions of the structured interview follow in Figure 3.10. Most structured interviews consist of questions referred to as closed, closed-ended, pre-coded, or fixed choice (Bryman and Bell, 2011). This phase consisted of closed-ended questions, participants receiving exactly the same questions from the researcher and being offered a limited choice of possible answers. The advantage of closed-ended question is that participants can answer in their own terms (Bryman and Bell, 2011). Moreover, closed-ended questions increase the equivalence of answers, making it easier to present the relationship between variables and compare between respondents or types of respondents (Bryman and Bell, 2011).

Conversely, there are some disadvantages of the closed-ended question, for instance, it can be difficult to writing down verbatim what participants say to researchers (Bryman and Bell, 2011). Furthermore, in the interview section, a large number of closed questions may make it difficult to establish a rapport, because the participants and researchers are less likely to engage with each other in a conversation (Bryman and Bell, 2011).

Therefore, the main purpose for Phase Three was to validate and confirm the results for this study. Therefore, the structured interview was applied to discuss the findings from Phase One and Phase Two. A comparison between the results from these three phases supported the arguments from the three groups according to the research questions and research objectives for this study. The finding on the relationship between SSCM and SRES was mentioned, and SResSCM practices were explained, with supply chain performance and SResSCM short and long-term impact during the structured interview section. The structured interview protocol was represented in Appendix C.

3.6.2. Data collection and data analysis

All participants in Phase Three were in Thai manufacturing, as the research context for this study. Participants received the questions before the interview section began to prepare their answers and some questions to discuss during the interview section. All participants were volunteers, so this phase was receiving information from those who were interested in the SResSCM topic. The researcher used face-to-face structured interview technique to conduct the interviews, using a paper and pencil approach. As same as Phase One, Phase Three also applied content analysis for data analysis and the same process as applied in Phase One (Figure 3.11). Further, snowball sampling also was used in Phase Three; however, there are five interviewees from Phase One that participant in this phase. Some of interviewee's in Phase Three also filled a questionnaire survey in Phase Two, and they have an interesting to participate in interview section with the researcher, as the researcher provided option to all survey respondents to participate in Phase Three. Then, the

researcher contacted new interviewees by telephone or email to give them more information about this thesis. Some of interviewees are from the researcher's ex-colleagues suggestions as same as Phase One. However, the researcher needs to review and check about the interest interviewees before initial to contact them. Therefore, all of interviewees in Phase Three are in a population of this thesis and these interviewees also have knowledge about SSCM and SRES in their organizations, thus these sample groups would be increase more reliability for this study.

3.7 Ethical issues

Ethical issues are increasingly important factors, which impact on new research studies. Blumberg et al. (2005) explained that research ethics are research processes that integrate moral and responsible methods during the handling of data. Moreover, The Oxford English Dictionary defined ethics as "a set of moral principles and rules of conduct, morally correct, honourable". Runeson and Höst (2009) stated that ethical issues combine with informed consent, review board approval, confidentiality, handling of sensitive results, inducements and feedback.

This study employed an ethical stance on the confidentiality of the information provided during the interview sections (Phase One and Phase Three) and survey (Phase Two). The study applied the procedure from Hull University Business School to ensure ethical approval was obtained from the school. Related forms and documents, i.e. interview outlines and a sample of the questionnaire, were submitted for review and approval from the school before collecting the data. This process supports the protection of participants and researcher from any concerns, and reserves participants' rights, to protect the reputation of the research and their organization. The selection procedure for participants was essentially based on relevance to the research purpose, and supreme consideration was given to avoid any bias in the selection of respondents in terms of gender, race and ethnicity. The participants in all stages of the study had the opportunity to stop, or decline to answer some questions during the data collection at any time. Anonymity was

assured and maintained for all participants in the research. The completed consent form is shown in Appendix D.

3.8 Summary of Chapter

This chapter has explained in more detail the existing empirical results for this study. Initially, the main concepts of the research philosophy were provided. Epistemology deals with the nature of knowledge; ontology with the nature of reality; and axiology is concerned about the influence of values in research. Different concepts within these categories lead researcher into two main paradigms: quantitative or qualitative research. Quantitative research usually appears as positivism, objective and unbiased approach; a qualitative researcher leads to the opposite side. For this study, the pragmatism paradigm was a suitable option for the exploratory nature of this new research phenomenon. The research design for this study consisted of quantitative method (a questionnaire survey) and qualitative method (a semi-structured interview and structured interview) to gain as many insights as possible from the real world. Moreover, this study also applied ethical issues during the research, related to HUBS research ethics committee procedures. The next chapter will explain the research findings from Phase One: Semi-structured interview analysis and results.

Chapter 4 PHASE ONE: SEMI-STRUCTURED INTERVIEWS ANALYSIS AND RESULTS

4.1 Introduction

Chapter 4 presents the results from Phase One: semi-structured interview for this study, which was conducted between October and November, 2015 in Thailand. The main purpose of this chapter is to review the understanding and current implementation of SSCM practices and SRES practices by companies, investigate the relationship between SSCM and SRES and define performance measurement used from the practitioner's perspective. The results and analysis from Phase One will provide the basis and knowledge required for Phase Two of the research design, which commenced in April 2016. This chapter uses the following sequence: semi-structured interview finding, interesting issues, development of questionnaire protocol and finally the conclusion.

4.2 Semi-structured interview analysis

Six companies, with nine interviewees were included in Phase One. The interviews were held either on company premises, or at a suitable place for each interviewee. Each interview was conducted by the researcher and recorded onto audiotape. The audio recordings and interview notes were controlled with confidentiality, so as not to be harmful to interviewees or their companies. However, before starting each interview, the researcher gave interviewees general information about the scope and purpose of the interview, and sought permission for the use of audio recorders to obtain approval from interviewees.

4.2.1. Companies and interviewees information

There were some companies in Phase One where the researcher needed to interview more than one interviewee due to the unspecific nature of SResSCM. The researcher would hence gain more understanding from using different departments. Information on the companies used for interviewing participants is as follows:

Company A (Interviewee 1)

The company is an American company, which designs and develops wafer (that use in integrated circuits) and does environmental testing equipment in Thailand. The headquarters is in California, USA and their plant is in Chonburi, Thailand. There are two types of products, being control power management and power management. The primary product is Integrated Circuits (ICs) as semi-conductors. The company is among the top five analogue IC producers in the global market. The main activity of the company is electronic manufacturing (OEMs) as a 2nd Tier supplier in electronic supply chains. The company has an annual revenue of more than 200 million baht (more than £4 million), with more than 200 employees. Interviewee 1 has their experience in this company about 3 years but he has experiences in electronic industry more than 20 years. So the interviewee 1 has a good experience from the past until the present. For example, during a huge flooding in Thailand, interviewee 1 was assigned from the mother's company to rescue and protect his company and their product, so he needs to plan and move their employees before the flooding. Thus, interviewee 1 would provide more insightful about resilience in Thailand.

Company B (Interviewee 2, 3, and 4)

The company is a semi-conductor manufacturer that produces products concerning flash memory in NAND and NOR categories. Most customers are part of the automotive industry. The company has a production line in Bangkok, Thailand; their headquarters is in California, USA. The company is defined as a 1st Tier supplier that provides materials for manufacturers. The main activity is electronic manufacturing (OEMs), with quarter revenue of around $200 million (£120 million) and more than 1,000 workers. Interviewees 2, 3 and 4 have their experience in this industry more than 20 years. As company B had their plan about the flooding in 2011, so all interviewees had the same goal as how to survive with this disruption. The interviewees had a different action for that time. For example, interviewee 2 needs to pack out finished goods for the last order before the flooding, interviewee 3 needs to check and prepare the inventory during the flooding or interviewee 4 needs to find the best route to deliver finished goods to the airport. Therefore, all interviewees had experience from huge flooding in Thailand. Moreover, according

to sustainable concept in the company, all interviewees need to follow and apply the sustainable concept into their department, thus these groups from different department would provide inevitable important information about sustainable and resilience in company B surely.

Company C (Interviewee 5 and 6)

The company is an air conditioning manufacturer that produces products for home use and industry. The company is situated in Bangkadi Industrial Park, Pathumthani, Thailand, and is a joint venture between two well-known foreign companies. The company buys some parts from suppliers and also produces its own products. The company is a focal firm in supply chain, being electrical manufacturers (OEMs). Their annual revenue is more than 200 million baht (more than £4 million) with around 1,000 employees (500 office-based and 500 operations- based). According to the experiences of these interviewees, interviewee 5 has worked in this company about 20 years, while interviewee 6 has about five years experience in this company. These interviewees from the same company have the goal from mother's company about sustainable and resilience concept. Moreover, interviewee 5 and 6 also faced the flooding in 2011, so they need to plan and prepare their employees to overcome this disruptions as same as other companies. So these interviewees will provide an essential action from that period, which was used successfully already. Moreover, regarding to sustainable concept in company, both interviewees need to take an action about sustainable concept with their department, so their action also related to sustainable study as well.

Company D (Interviewee 7)

The company is an IC Design Manufacturer, which provides novel, custom and standard design microchips for RFID applications and distributes products, which carry high-value added features with excellent overall systems performance. The main product is Integrated Circuits (ICs) with radio frequency identification (RFID), but the company also provides Custom Asic Design for other customers. However, the company does not have their own production line, but uses outsourcing for their manufacturing as a 1st Tier Customer. The annual revenue is about 300 million

baht (approximately £6 million), with around 70 employees. The company is a Thai company, and their office is in Bangkok, Thailand. Interviewee 7 works in this company about 2 years but he works in electrical and electronic industry more than 15 years. So he has a lot of experience in his field. From the past, he worked in multinational company but for now he works in 100% Thai company, so he applied and adopted his experience from the past to drive his current company to global market. Interviewee 7 also has the knowledge about sustainable and resilience concept, for example, he needs to provide an eco product to their customers or he needs to prepare company's action to their customers during the disruptions. Therefore, interviewee 7 also has insight information about SSCM and SRES that related to this thesis.

Company E (Interviewee 8)

The company is a multinational company that operates logistics services in Thailand for warehousing and transportation. The company has five categories in their business, being automotive, spare parts and technology, consumables, retail and E-commerce. The company is among the top three service providers in the world. They define themselves as a 1st Tier customer, and they are an electronic distributor in the context of this thesis. The company has lots of warehouses and hubs in Thailand. The annual revenue is more than 200 million baht (more than £4 million) with more than 10,000 workers. Interviewee 8 is a junior management from Company E that has an experience with their role about two years. However, he also had many projects during these years, which related to sustainable and resilience concept from his company. For example, interviewee 8 had a project related to green warehouse for supporting his customers or he needs to find the possible route to deliver customer's product during the flooding period. Consequently, interviewee 8 also is in the sample group of this thesis.

Company F (Interviewee 9)

The company is a Japanese service provider that provides transportation in road, sea and air in Thailand. The parent company is in Japan and they have an office in Thailand as well. The company is among the top ten service providers in Japan. The

company is a 2nd – 3rd Tier supplier in the supply chain, and they are an electronic distributor in the context of this thesis. The company is medium size, with some suppliers and outsourcings. Interviewee 9 works in Company F about 10 years, which his customers are in electrical and electronic industry, by supporting transportation to deliver customer's product in different route. He also needs to follow his customers about sustainable and resilience concepts, thus interviewee 9 will provide these concepts in different perspectives from manufacturers as distributor for this thesis.

Accordingly, Table 4.1 summarizes the interviewee profiles. Consequently, all interviewees were screened to ensure they had relevant experience and industry knowledge. Thus, they are all considered key informants due to their position in organization, length of time in organization and industry, etc.

Table 4.1: Demographic information of interviewees in Phase One

Company	Interviewee number	Position in company	Company size	Product	Position in SC	Type of company	Origin of Company	Location	Year Experience	
									@ Company	@ Industry
A	Interviewee 1	General Manager	Large	Integrated Circuits	2nd Tier Supplier	Electronic OEMs	Multi-national company	Chonburi	3	>20
B	Interviewee 2	Physical Distribution Manager	Large	Integrated Circuits	1st Tier Supplier	Electronic OEMs	Multi-national company	Nonthaburi	>15	>20
B	Interviewee 3	Purchasing Manager	Large	Integrated Circuits	1st Tier Supplier	Electronic OEMs	Multi-national company	Nonthaburi	>10	>20
B	Interviewee 4	Traffic Manager	Large	Integrated Circuits	1st Tier Supplier	Electronic OEMs	Multi-national company	Nonthaburi	>10	>20
C	Interviewee 5	Purchasing Manager	Large	Air condition	Focal firm	Electrical OEMs	Multi-national company	Pathumthani	>10	>20
C	Interviewee 6	Product Planning Manager	Large	Air condition	Focal firm	Electrical OEMs	Multi-national company	Pathumthani	5	8
D	Interviewee 7	Co-Chief Executive Officer	Medium	Integrated Circuits Design	1st Tier Customer	Electronic OEMs	Thai company	Bangkok	2	15
E	Interviewee 8	Senior Supply Chain Development	Large	Warehousing and transportation	1st Tier Customer	Electronic distributor	Multi-national company	Around Thailand	2	4
F	Interviewee 9	Key Account Manager	Medium	Transportation	2nd – 3rd Tier supplier	Electronic distributor	Japanese company	Around Thailand	10	>10

4.2.2. Process for Phase One

As explained in chapter 3, the interviews were recorded, transcribed from voice to words, and translated from Thai to English. Then, all documents were imported into the NVivo software programme for coding and setting categories for analysis by researcher (Figure 4.1).

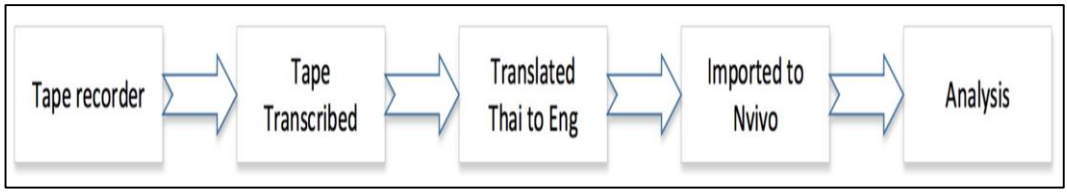

Figure 4.1: Analysis process for this phase

As presented in Figure 4.1, there are five steps for interview section. The following is explained about these steps.

1) Tape recorder

Before begin to interview each section, the researcher asked all participants for the permission to record conversation with audio-recoreded. So all conversation between the researcher and all participants were recorded and stored by the researcher.

2) Tape transcribed

After the interview section, the researcher transcribed recorded-tape with the researcher's notes in Microsoft Words Application.

3) Translated Thai to English

The interviews were conducted in Thailand, in which the native language is Thai. Therefore, the interview questions had to be translated from English to Thai, and the interview answers had to be translated Thai to English, respectively.

4) Imported to Nvivo

Further, the researcher also applied the Nvivo programme for grouping the findings from the interview section within the same category. All documents were imported

to Nvivo proagramme, which was used to analyse the large amount of findings. Bryman and Bell (2011) defined coding in qualitative research as “the process whereby data are broken down into component parts, which are given names” (p.712). According to Bryman and Bell (2011), this thesis used coding manual for content analysis because “the coding manual enables the message content to be coded in a consistent manner” (p.300), which coding manual was referred to “as the content analysis dictionary, is a statement of instructions to coders that specifics the categories that will be used to classify the text based on a set of written rules that define how the text will be classified” (p.300). Moreover, Nvivo software was used to combine and code in the same screen. Thus, this programme supports the researcher to do coding for this study.

5) Analysis

The researcher has undertaken a qualitative analysis using content analysis to achieve a better understanding of SSCM and SRES from Thai’s industry. The advantage of content analysis for this thesis is “content analysis can allow information to be generated about social groups and different to gain access to” (p.305) (Bryman and Bell, 2011). Furthermore, Seuring and Gold (2012) argued that “content analysis is suitable for analyzing various qualitative and unstructured data such as those collected during unstructured or semi-structured interviews or web-based documentary research” (p.546). Moreover, Krippendorff (1980) defined content analysis as a method of combining the text of writing into different groups or categories regarding to selected criteria, which the frequency represents an important wording. Therefore, content analysis is a suitable analysis for this thesis.

The researcher would like to develop the themes based on the findings from Phase One. Figure 4.2 presents the sample process for interview analysis steps based on themes that emerged during interview section. The researcher can create categories to summarize the findings from participants, who were interviewed at different dates and times, with the same questions. The findings from Phase One were presented in different topics, i.e. the understanding of SSCM, SRES, SResSCM and performance measurement and the relationship between SSCM and SRES.

Consequently, the findings, after grouped in Nvivo programme, were analysed with content analysis individually according to interview protocol by the researcher.

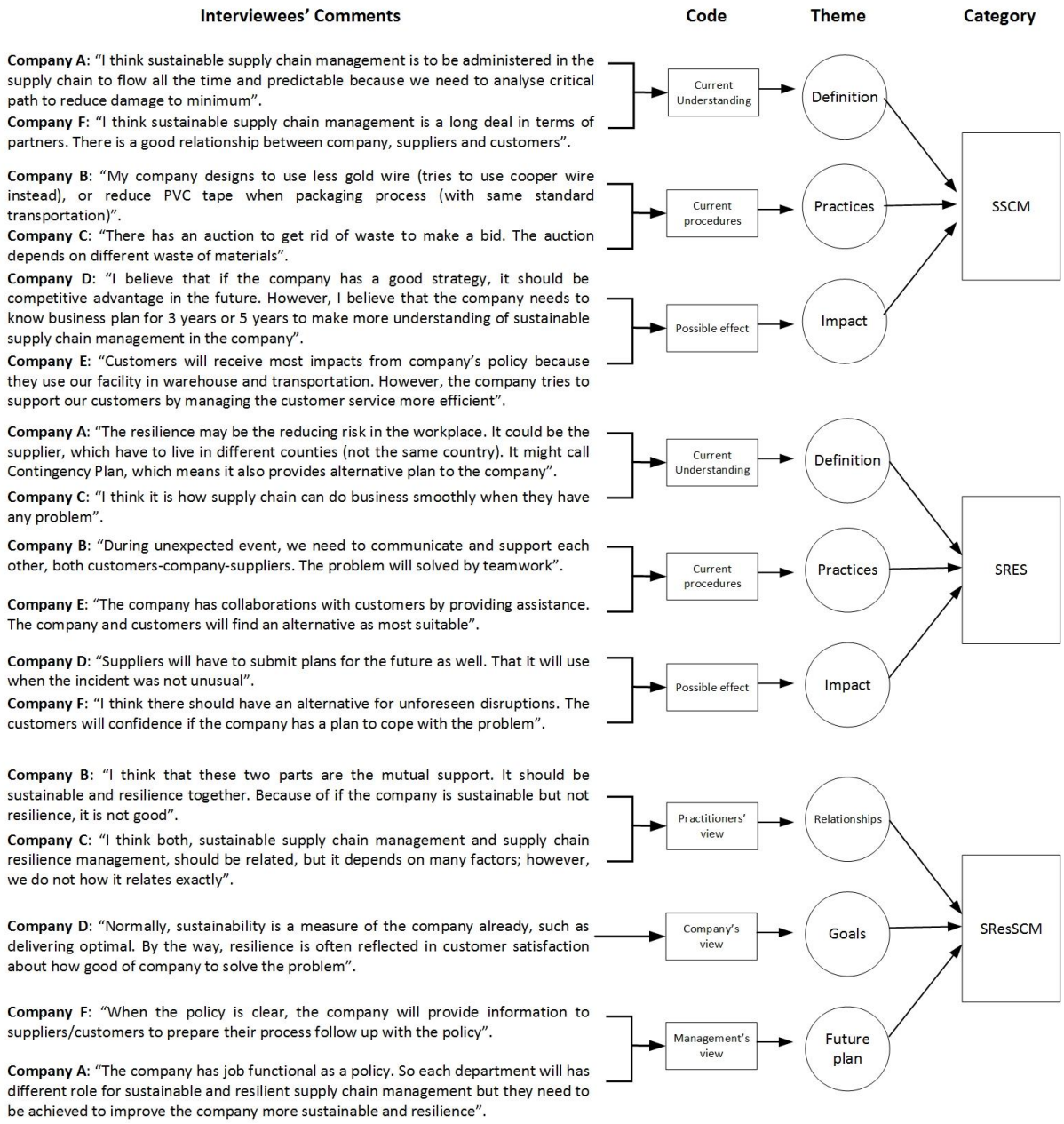

Figure 4.2: Examples of interviewee's analysis for Phase One

However, this study cannot provide the full transcription from all interviewees due to words limit, so the researcher provides an example of one interviewee in Appendix N. Next, the following sections will present the data analysis from Phase One of this study.

4.3 The understanding of SSCM

The concept of SSCM, as stated in Chapter 2, was different for each company in Phase One. However, most companies already had a SSCM policy and established practices. The following section presents the SSCM topic from Phase One in terms of definition, practices and impact of SSCM on the company.

4.3.1. SSCM definition

Regarding to the question about understanding in SSCM definition in Phase One, it can be seen that SSCM displayed different ideas from practitioners' perspective, such as the environment, price, partnership, risk assessment, or long-term relationship. For instance, Company A thought that "SSCM should be administered in the supply chain to flow predictably all the time, because the company needed to analyse critical paths to reduce damage to a minimum". Company A also believed that "it was unnecessary to manage SSCM in the company alone, but that the company needed to communicate with suppliers/customers to reduce investment cost". Moreover, Company B, Company C and Company F thought that "SSCM is how to cooperate with suppliers and customers as a partner to be more sustainable and it is a long deal in terms of partners". Furthermore, there should be a good relationship between company, suppliers and customers, as Company B highlighted that sometimes the company requires the supplier to be a green company, so suppliers need to improve their production or products to be more sustainable to fulfil the company's requirements. Moreover, customers may require ISO14001, so the company needs to achieve ISO14001 as well, suppliers also being required to achieve it at the same time. Thus all part of the supply chain – suppliers, manufacturers, customers (stakeholders) - must be sustainable at all times.

While not all companies mentioned SSCM in relation to economic or social perspectives, such as the TBL dimension from Carter and Rogers (2008), all were looking to be more environmentally friendly, build a partnership with suppliers/customers, and looking at economic perspective as a cost saving means in the company. Therefore, when the researcher described the definition of SSCM

based on Carter and Rogers (2008) to the companies, they argued that their company had TBL dimensions such as environment, economic and social scope. Nevertheless, most were looking to be more environmental in policy than other aspects. It was found that the social dimension in companies was mainly in the form of Corporate Social Responsibility (CSR), while the economic dimension paid attention to reducing cost, reducing materials, improving productivity and also selling waste with the right solution. Thus, it can be assumed that all companies had applied the definition of SSCM in the company's policy already, but the employees or workers were either not aware of this definition, or the company had not announced a clear definition of SSCM policy.

4.3.2. SSCM practices applied in the company

Various SSCM practices have been identified in academic research, and some sustainable supply chain policies are used by companies, but not to any large extent. For example, Company A stated that it had a sustainable supply chain strategy that would be better with a business partner who was doing business with the company for a long time. Moreover, Company C mentioned that their company had rules on safety (Environmental Health and Safety) and had adopted waste disposal policies for controlling chemical waste and disposing of it correctly. This was because the company produced products from hazardous materials and therefore needed to focus on it. Furthermore, the representative from Company D commented that the company had standard policy only, i.e. turning off lights during lunchtime, or turning off the screen when not in use. Similar to Company E, he referred to his company's policy on the installation of solar cells in warehouses and distribution centres. Some warehouses were open 24 hours a day, so the company needed to save energy during the day to use at night. Moreover, the company used material handling equipment (MHE) in the warehouses that reduced pollution. On the other hand, Company B mentioned that, while the company had not announced any specific sustainability policy, it did use environmentally friendly practices, i.e. air pollution control, volume control and CO_2 emissions control, together with corporate social responsibility (CSR) in the company. This was similar

to a comment from Company F about unclear sustainable supply chain policy in his company, which nevertheless had a plan to develop SSCM in the next five years or more.

The essential point is that all companies had more plans to develop SSCM policy than previously. For instance, Company B confirmed that their company planned to develop a superior ISO to the one the company already had, as part of company plans to improve its factory to a more superior norm. Furthermore, Company D argued that the company planned to develop a process to improve activities such as repackaging to achieve efficient delivery, as these activities would reduce logistics cost as well. Company E also said that the company would announce a long-term period of 5–10 years for the provision of a new policy to improve SSCM activities.

As for the reasons behind the adoption of a SSCM policy, the interviewees had some arguments related to SSCM practices. For instance, Company A explained that because the company was in a volatile market, in which their consumers were sensitive to brand image and production, the company needed to fulfil customers' requirements, and that some policies should be more sustainable in the future. Likewise, Company B stated that because the company needed to follow the mother plant's SSCM policies and respond to society at the same time, this forced it to implement SSCM implicitly. Meanwhile, customers preferred to do business with partners who were likely to be environmentally friendly in the future, so the company would alter its production to become more environmentally friendly. Similarly Company C clarified that "the rules may have evolved from the mother company and it will impact on our employees". In other words, based on the mother's company's policy on green production, the company would develop rules according to the mother company's requirements.

In addition, some interviewees mentioned reasons in the economic dimension. Company B said the company looked at Return on Investment (ROI); if it is worth investing the company will invest in being more sustainable because it believes that a sustainability policy would support an increasingly good relationship with

neighbours around the factory or surrounding communities. The management team trusted that if the company was sufficiently sustainable, there would be sustainability in its supply chains. Furthermore, Company E cited that the company had a Business Case Assessment (BCA) procedure concerning the return on capital, investment, ROI, and Observe, Record, Classify and Evaluate (ORCE). Hence the company would know the best choice when selecting. The management team reviewed risk management and selected suitable investments for the company. In the meantime, the company was looking at two parts of the economic dimension - investment income and improved performance attitudes. Moreover, Company D explained that the company believed they would enjoy two advantages if the company had a strong SSCM policy, which could (1) build a brand image and (2) result in good business return (i.e. it might be accountable as return on investment, and uncountable as employee satisfaction in working for the company).

Finally, the reasons to implement SSCM policy and procedures were different for each company, but there was the same main aim of doing business with more efficiency and effectiveness. Therefore, the company would implement SSCM policy according to the nature of the business, cost and return on investment, business trends and social pressure.

4.3.3. Impact of SSCM in the company

Once SSCM has been implemented in a company, it has an impact in a different way. Firstly, SSCM always has a direct impact on suppliers. All companies follow the same direction in this sense, because SSCM policy has a huge impact on their suppliers to be more sustainable if they wish to do business with the company in the long-term. According to Company A, the impact would cause their major/key supplier, needed to audit their production, to become more sustainable. Moreover, Company F said that the company demanded more requirements from suppliers, which they needed to meet before doing business together. On the other hand, customers may also demand more SSCM practices of a company, and so the company needed to develop more sustainable processes to fulfil customers'

requirements. Furthermore, Company B stated that large suppliers had less impact than small suppliers, because SSCM policy already required improvement in suppliers' policies. Meanwhile, Company C indicated that when the company had auditing suppliers, it would review the standard certification, i.e. ISO or CSR, as a part of the company supplier audit requirement. Hence suppliers needed to fulfil these requirements, before the company would buy their products.

Secondly, most of the companies mentioned that the impact of SSCM policy came from their customers as well. For instance, Company A said "customers require more processes or activities to be more sustainable to the company, then the company needs to adapt process following the customers' requirements". Similarly, Company B stated that the company and customers had a code-of-conduct together, the customers requiring the company to audit suppliers directly. Meanwhile, Company E stated that customers who used their warehouse services and transportation had been impacted by the company's policy when it implemented SSCM practices, which they needed to acknowledge and to follow. Moreover, the company tried to support customers by managing its customer service more efficiently.

Thirdly, there were impacts of SSCM on a company's procedure, which also appeared in the interview section. For example, Company A mentioned that the company would have more processes and procedures to discuss in committee; however, the company trusted that if it could be sustainable on each point, it meant there was sustainability in the whole supply chain. Moreover, Company B suggested that the company should announce SSCM policy with a task for each related responsibility activity, such as: 1) what to do with it? 2) Which department needed to take an action? And then also let employees know about the action taken as part of SSCM policy. Company B thought that at the beginning of SSCM policy implementation, it would take time for employees or workers to change their procedures and processes; however, when SSCM policy had been implemented for a long time, it would become good practice for the company and employees. Meanwhile, Company F also mentioned the impact of SSCM policy in the short-

term, as can be difficult for employees to learn about new things and adapt to the activities of the company. In the long term, it is useful for employees who take this action, and the company will gain more benefit from SSCM. Furthermore, Company B also thought that costs would increase at the start of the implementation period, but with time, it would stabilize and costs would decrease later on. Moreover, Company D believed that if the company had a good enough SSCM strategy, it should be a competitive advantage in the future. For instance, when customers are looking to buy a new product in the market, they will select the company that has a good brand image compared with other companies (when products from all companies offer the same performance). However, he believed the company needs to implement a business plan for three or five years to make more understanding of SSCM in the company.

4.4 The understanding of SRES

SRES definition and practices have already been applied in Phase One. However, there are some arguments, which emerged during the interview section. The following section discusses the understanding of practitioners based on SRES concept.

4.4.1. SRES definition

In terms of SRES definition, the interviewees offered different definitions. Company A thought that resilience might result in reducing risk in the workplace. It could also affect suppliers, who may be based in different countries (not the same country). He also commented that his company calls contingency plan as resilience concept. Meanwhile, Company F argued that SRES was not clear in his company, but that it might be the contingency plan that the company already had. Moreover, Company D mentioned an interesting definition of SRES as, “it is a balance of many key factors for an unexpected event”. The company should prepare a short and long-term plan, i.e. when unexpected events happen, what the company should do within the first 24 hours, and also what to expect and how to manage it. Company E also supported the definition of SRES as a Business Continuity Plan (BCP), used to

prevent the unexpected. Company B and Company C shared the same main idea of SRES as allowing the company to continue doing business smoothly when they had any problems, and enabling the supply chain to support each member. There was an attractive concept from Company B: “SRES looks like SSCM because it requires managing the entire supply chain in both sustainability and resilience. If we look at the products, products must be sustainable and resilient themselves (in order to continue to sell) and they also need to support each other”. Company D mentioned that the company needed to have a risk assessment for all activities that could impact on operations/production, and also needed to focus on indirect materials as well, because if indirect materials run out-of-stock, the process would be disrupted in the same way as if direct materials ran out-of-stock.

Therefore, the definitions of SRES from Phase One were different from each company. However, the main point from the interviewees was that company/supply chains can do business when disruptions occur by preparing a contingency plan and communicating with suppliers/customers to recover their supply chain to a normal level as soon as possible. Even though the contingency plan cannot replace 100% performance, the company should have it to maintain customer satisfaction and improve effectiveness and efficiency in the future. The following definition was mentioned, in concurrence with many authors, that “SRES is the ability to prepare for unforeseen disruptions with the ability to recover from them faster than competitors” (Chopra and Sodhi, 2014; Christopher and Peck, 2004a; Jüttner and Maklan, 2011; Rice, 2011).

4.4.2. SRES practices applied in the company

For SRES procedure, as mentioned before, all companies prepared 2nd or 3rd sources of suppliers/3PLs to support the company during the disruption period. There were also some preparation plans for warehousing, transportation, purchasing and operations, and also a certain amount of risk management. For instance, Company A cited that the company had a risk assessment and escalation procedures, which managers needed to know in order to take action in unforeseen situations and to

manage and control the supply chains. Similarly, Company D mentioned, “my company has Business Continuity Plan for risk management”, to be used when unexpected events happened. The company would return production/operations to normal as soon as possible. However, the problem with unforeseen events is that the company cannot know when these events will end. Moreover, distributors such as Company E and Company F also stated that the company had risk management/risk policy to avoid risk by communicating with their suppliers/customers and finding an alternative for their customers.

Furthermore, there were some good examples from company experience. For instance, Company B explained that the company had occasions when their suppliers could not deliver frequently enough; the company hence had plans for unforeseen disruptions (by preparing 2nd or 3rd plans for the future). Consistency plans could be used for any periods of disruption, depending on the situation. During the course of the problem, the company would hold management meetings to analyse and conclude on selecting alternative sources. The company would thus find the best solution. As to whether the company would discuss and communicate with their suppliers to prepare plans together, Company D described that his company needed to apply SRES in their policy because suppliers or contract manufacturers had to provide contingency plans to the company as well for unexpected events. Meanwhile, Company D stated that the company had two plans for unforeseen disruptions: 1) Business Continuity Plan, which helped the company to prepare an action from point to point, and 2) Disaster Recovery Plan, which was used to link plans between suppliers, customers and the company in order to work more effectively. Moreover, most of the companies (Companies C, E and F) inferred that the company would contact suppliers/customers when disruptions occurred, and would communicate continually during the disruption period. In the meantime, there was an interesting point mentioned by Company E about customer requirements. The company needed to protect their products when disruptions occurred, so customers could get their products direct from the warehouse, where Company E had delivered, although this might involve more risk and cost to themselves. However the company offered other alternatives, such as transport

using special methods (such as carrying by hand for small parcels or by motorcycle in a dangerous area, although the company could not guarantee a shipping date because they needed to protect their employees as well).

Furthermore, it can be seen that most of interviewees believed that SRES was very important for the company. As Company E and Company F stated, the company should have an alternative source or plan for urgent times. Furthermore, all companies cited that when disruption occurred, the company plan needed to be in place to increase the confidence of customers to do business with the company as a partner (meaning that customers could trust the company to continue production).

On the other hand, companies also needed to support their suppliers. For example, Company E stated that his company would discuss finding ways to support customers according to their requirements if possible. Similarly Company B explained that the company sends the engineer to the supplier's plant/manufacturer to support their work in performing normally. However, the company needed to help their suppliers to become more resilient in the future, and to do a business with the company for as long as possible (depending on the supplier's performance and capacity to improve it).

Regarding future plans for SRES in each company, there were good trends for all companies in the interview group, the interviewees stating that the company would develop and prepare plans for unforeseen disruptions in the future. For instance, there was a plan after one company faced certain disruptions to protect and prepare for future disruptions. Some interviewees explained that their company had a team to prepare and follow strategies for unforeseen disruption. Company C stated that the company had a Business Continuous Programme (BCP) for all departments, and would practice unusual moves to prepare for unforeseen events. Meanwhile, Company E explained that the company had an Operations Excellence (OE) team that would update news and review unusual events for the company. The OE team would analyse appropriate methods of delivery for the transportation department, and also inform customers about problems. Moreover, Company C

commented that the company would prepare to move equipment and practice their plan for future events. Furthermore, Company D announced that the company would be implementing a supply chain resilience management policy soon.

4.4.3. Impact of SRES in the company

As with SSCM, SRES had an impact on suppliers, customers and companies as well. Most of the companies agreed that it provided good things for the company and also it had a positive impact on suppliers/customers, rather than a negative impact. For instance, Company D stated, “in my opinion, SRES should start within the company first, and then share the critical point to suppliers/customers for preparing future plans (this might be requirements from the company to suppliers/customers). Because if the company has action plans to cope with disruption effectively, the company will manage and control the problem easily. It depends on how fast it copes with disruption events; if not very difficult, it will be handled according to the plan. For customers, it is a good impact because it looks like a guarantee that the company has prepared action plans for disruption periods. On the other hand, suppliers required more action plans to cope with company plans. However, the selected action plan will choose by the management team when disruption happens”. Company B also explained their view of SRES in the present, as “according to SRES policy, it seems like a trend in the business world over but it is a good thing to make the company aware of it. This will make society aware of the consequences. It has a high cost to invest in SRES policy but it makes sense to invest. The company will be more helpful if the contributions are to society rather than the company itself”.

Some companies mentioned the impact of SRES on suppliers. As Company A argued, “suppliers need to have more inventory buffer (called Kanban) for the company and also they need to provide contingency plans to the company. However, the company needs to support suppliers to improve their capabilities and performance. The company believes that if the company can reduce risk, the damage caused by the suppliers will decrease”. Meanwhile, Company C explained

that suppliers would have to submit plans for the future as well, to use when the incident was not unusual, and that the company could review the suppliers' audits to check on their plans for unforeseen disruptions. Hence the suppliers needed to prepare these plans for the company.

On the other hand, Phase One also mentioned the impact of SRES on customers. For example, Company E argued, “due to most of customer’s products being sent from abroad, the company needs to store and distribute when customers require, so customers will be confident more than before if the company has planned for unforeseen disruptions”. Moreover, Company B argued that it would mean late delivery to customers from the start of disruptions, and that customers might use others source to meet their demands instead. Hence the company needed to share the information with its suppliers to resolve the problem. Furthermore, Company B explained, “it is good impact for customers because the company needs to prepare a contingency plan and recovery plan to demonstrate to them the action and time-line to recover our production”. On the other hand, suppliers needed to prepare their strategy and plans for unforeseen disruption for the company (just as the company gave to the customer). The impact of SRES would hence support supply chains in becoming more resilient.

4.5 The understanding of performance measurement

Performance measurement is one of key points for this study. All companies in Phase One had different opinions on the measurement process. For example, Company E thought that performance measurement should be objective about how to measure before measuring, asking what is measurement? Why do we need to measure? The results from this measurement should answer these questions. Moreover, Company D stated, “I believe that performance measurement is a mirror that reflects the company’s process or procedure, which are the delivery of product on time, production time within cycle time. These measurements can be divided into two groups as lagging and leading, both of these should be included in performance measurement”. Meanwhile, Company A thought that performance

measurement should be used to measure the lead-time for delivery, product quality, cost saving, production effectiveness (commit date to ship), and no-delay delivery. Furthermore, Company B thought that it could measure in two ways: 1) Production output that could be done right on target, 2) On time delivery (OTD) that could be delivered directly to the customer, or not.

Meantime, Company B suggested that performance measurement should involve measures in cost saving, ensuring supply, quality and process. There are measurements that would support workers in being able to operate efficiently at lowest possible cost to the company and to operate smoothly. Similar to Company C, they argued "it would look at Query-Cost-Delivery-Service (QCDS) which is an evaluated topic already. The company will focus on the whole process more than on the quality and cost (it depends on which one is important)". Furthermore, Company F commented, "the company always measures On Time Delivery (OTD), or transportation without waste". Therefore, all companies had different performance measurement indicators, but they knew the reason for these and how to measure the performance in their own way. Thus, the new measurement from this study should be measurable and simple to use for all companies. Based on the performance measurement from each company, some insights emerged from Phase One, which are discussed below.

4.5.1. Performance measurement in the company

Firstly, regarding performance measurement in general, Phase One mentioned different key performance areas among companies. Company A described measurement of transportation as "the company measures effectiveness of transportation (commit to ship on time), and cost saving for the electronics industry". Company B also mentioned that, for transportation, it was on time delivery (OTD) that related to tangible factors, i.e. product quality and return of investment (ROI), and intangible factors, i.e. customer satisfaction, environmentally friendly elements and employees' emotional needs. Furthermore, Company D thought performance measurement might relate to delivery on time for the

sustainability and response plan, with up-to-date information, for resilience. In addition, Company B highlighted that there were some other points such as the measure of control on power consumption, wastewater discharge, and the welfare and health of workers.

Secondly, performance measurement related to SSCM and SRES in the companies. Phase One also highlighted different factors in performance measurement. According to Company B, “Normally, the company has a standard audit (as ISO14001) every year, and checks the amount of utilities bills (water and electric that are tangible) as part of the company’s performance”. Meanwhile, the company had received various awards from different institutes, so it can be assumed that the company had performed well. Company E stated that the company had certain measurements such as measuring energy saving, re-used paper and internal competition, while Company C revealed that the company used Query-Cost-Delivery-Service (QCDS) performance to measure suppliers and production, using the percentage of reduction cost as a performance measurement. Company D mentioned that “for sustainability measurement, it should have five factors as: Cost, Delivery, Quality, Service, and Flexibility”. This was calculated with a score of more than 80% (average all factors). On the other hand, resilience should involve a plan for unforeseen disruptions in the business plan that can react and offer support to customers quickly and effectively. However, Company F mentioned that they did not have clear performance measurement in SSCM and SRES at this time.

Thirdly, some companies suggested appropriate performance measurement factors for further improvement, such as the advice for Company B that “for social perspective, it should be a good relationship with the surrounding communities and less argument with the communities; while, for resilience perspective, it should be a customer satisfaction, which are 1) low customer complaints, and 2) low customer corrective action requests (CCAR) about product quality. Company F believed that sustainable and resilient measurement factors might result in better customer satisfaction. In addition, Company B commented that performance measurements of CCM and SRES should be suitable for company, suppliers and

customers, because it would help suppliers-manufacturers-customers by improving the supply chain performance. Moreover, Company E said, “I think it is difficult to measure because most of these are unmeasured, which requires a long-term view rather than what can be done”. Therefore, it can be assumed that these measurements can measure sustainability and resilience in the company.

4.5.2. Barriers to measurement of SSCM and SRES in the company

There are some arguments from Phase One about the barriers to the measurement of SSCM and SRES in companies. As mentioned by Company C, “I think we really need to measure performance that can measure. However, some measurements cannot measure, so the company needs to assess with more evidence to be traced back to it and develop measurement, which can measure for all factors”. This concern also related to Company B, explained as, “basically, the measurement factors should be tangible or measurable so it is difficult to measure SSCM and SRES because most of these factors are intangible”. Furthermore, Company F mentioned, “the company will communicate about the measurement with customers first, and then improve the measurement to be more efficient; however, the company will support customers’ requirements first”. Lastly, there was an interesting point from Company A that the barrier to performance measurement was that when the company used score cards for measurement they needed to measure in scale data (i.e. 0, 1, 2, 3…), rather than measuring in digital form (0 or 1 or pass or fail), because it may create unfair measurements and put more pressure on the entire supply chain.

4.6 The relationship between SSCM and SRES from Phase One

The relationship between SSCM and SRES was discussed in Phase One. The findings from this section will present the practitioner’s perspective on this relationship. The researcher would like to define the relationship between SSCM and SRES from practitioners’ perspective. Based on the findings from this phase, most of the companies explained that there is linkage between SSCM and SRES from their perception, but it is not an obvious relationship that interviewees can explain

during the interview section. For example, Company C and Company F thought that SSCM and SRES were related, but needed to see which played the major part, i.e. sustainability or resilience. Furthermore, Company A also commented that there were relationships between suppliers-manufacturers-customers that needed to have sustainability and resilience together. Meanwhile, Company D thought that sustainability had to involve resilience, because sustainability is how to maintain the business for a long period of time, while, resilience is how businesses return to their present status after encountering any disruption. Therefore these two concepts support each other. Company B argued, "if it is resilience, it should be sustainability or if it is sustainability, it should be resilience; thus these two dimensions are a support to each other. It must be good if the company has all dimensions". However, Company B also mentioned, "I think that these two parts are the mutual support. It should be sustainable and resilient together, because if the company is sustainable but not resilient, it is not good. However, due to the company's product (very fast moving goods), it might be resilient but not sustainable".

In terms of the proportion between SSCM and SRES in a company, Company B believed that sustainability should come first and resilience should follow, while Company E believed that it should be 60% Resilience and 40% Sustainability. Thus, there is still unclear definition of the relationship between SSCM and SRES from the practitioner's perspective. However, the interesting point that emerged from Phase One was that not only do companies need to be more sustainable; they need to improve their resilience as well.

Nevertheless, during the implementation period of sustainability and resilience policy, there can be some problems/issues. As Company A stated, "managers need to explain to workers/employees to follow with the policy but it is difficult to do that because it might make more process in production which employees do not want to follow". However, Company B suggested, "the company will not receive any problems when the company studied before a policy is implemented (the

company ensure that they can achieve this policy before launching by think-study-act step)".

4.6.1. Investigating SResSCM practices

Based on the development of SResSCM practices in Chapter 2, SResSCM practices were created by combining the relevant SSCM and SRES practices together and then define appropriate practices that can improve sustainable and resilience in supply chain at the same time. As discussed in Section 2.10.2 and 2.10.3, this thesis initially combined four practices from SSCM and four practices from SRES into SResSCM practices, which the researcher found that these practices have the relationships between them as ECO-design, green production, social responsibility, investment recovery, collaboration, recovery, external pressure and connectivity. Moreover, as discussed in Section 2.10, these eight practices were used prevalent in the existing literature and companies around the world. Therefore, the researcher selected these practices and developed the house of SResSCM, which combined these practices together, as in Figure 2.24, as a first step to determine the efficiency of SResSCM practices from practitioner perspective. Thus, the development of SResSCM practices in this thesis is related to the current practices that were used in the company. The results of each practice are explained below.

1. **ECO-Design**

As discussed in chapter 2, ECO-design is used for new material or for reprocessing the current product to be more environmentally friendly. ECO-design was applied by all companies in Phase One and was explained by each company. For instance, Company A mentioned, "it depends on product types, because if the product is not the end product, it is not necessary to apply ECO-design", while, Company B explained that "my company designs to use less gold wire (tries to use cooper wire instead), or reduce PVC tape when packaging process (with same standard transportation)". Moreover, Company B also cited that "the company has supplier's code-of-conduct to select suppliers, who produce environmentally friendly products; then suppliers need to sign a document following the company's

instructions about green supply chain. This will help suppliers and company work together with the same direction". In addition, Company C used ECO-design by reducing some components, i.e. cardboard, boxes that can be recycled, and, most importantly, air cleaners (O-Zone depreciation and Global Warming Potential – GWP) solutions such as R22, which are in the CFC group. The company tried to stop using these and to develop new products that are designed to be more environmental friendly. Furthermore, Company E cited that the company would design warehousing to help customers to be more environmentally friendly. In the meantime, the company used types of cars that could both support the company and support the environment as well.

2. **Green production**

Green production for this study included green purchasing, green process, green warehousing and green transportation. Some companies paid attention to reducing waste in production. For instance Company B stated, "the company tried to reduce CO_2 emissions and reduce energy usage and waste water treatment; trees are planted within the company to improve the company's environment and the company is required to produce products that will be environmentally friendly in all processes. The company follows the Electronic Industry Citizenship Coalition® (EICC) code and applies this code to its code-of-conduct in order to improve production efficiency". Company F also cited that "The company set the standard term of transportation that drivers need to follow to be safe and become environmentally friendly". Company E explained that the company separated green production into two areas: 1) to reduce the use of warehouse consuming, i.e. reduce tape, reduce carton sealing and reduce cost, and 2) to dispose of waste correctly. In the meantime, Company D mentioned that the company would select suppliers/contract manufacturers, who had environmentally friendly production/processes.

3. **Social responsibility**

This practice was applied by all companies in Phase One according to the human rights policy in Thailand. The companies described their actions as follows:

Company A said, “the company has social responsibility to create better a social image and support the university by developing modules which relate to the requirements of the local labour market”. Similarly, Company D mentioned, “the company has social responsibility by supporting education, which means the company will suggest modules for developing students to design new products for the future”. Most companies paid attention to employees and the surrounding neighbourhood, Company B citing that “the company is organizing outings every quarter, including, employee assistance, re-forestation, and supporting work-out facilities for all employees”. However, Company C explained that the company did not need to create a good image for the customer, but offered support to schools, the community and local society instead. By contrast, Company F announced that the company had no clear policy of social responsibility, but only adhered to the basic requirements of the Department of Labour that it needed to follow regarding welfare and safety in the company. These findings relate to the discussion in Section 2.10.3 that a company uses social responsibility to deal with employees, society and the world. Thus, all companies are interested in this practice.

4. <u>Investment recovery</u>

As demonstrated in Section 2.4.2, this practice involved the sale of scrap and used materials, and sale of excess capital equipment. Regarding the sale of waste, the purchasing department had a role to play, as stated by Company B. Here the procurement of raw materials was divided into three main categories: 1) Waste generated from production, which had no value as scrap paper or scrap wood. These could be purchased from junk shops; 2) Waste generated from production, which had worth as gold scrap, copper scrap or IC chips; 3) Hazardous items, which impact on the environment, would be eliminated by using outsourcing for disposal. However, these companies needed to have certificate from Government to get rid of waste legally. Additionally Company C commented that the company had an auction to get rid of waste by making bids, but the auction depended on the different types of waste materials. Moreover, Company D mentioned investment recovery related to the policy of the Board of Investment Thailand (BOI, Thailand). The company needed to follow BOI policy about import-export products, so

production required the distribution of both materials, goods and bad materials, to deal with waste auctions, and the company had 2–3 actions for waste management. Similarly, Company A argued that waste in production must be sold to waste disposal units, which are certified by the Industry Council of Thailand, because in ICs, there is gold involved which is affected by BOI regulations. Company F stated, “the company collected cartons from shipping to sell at waste disposal but there is no check to waste disposal about their process (the company did not check waste disposal about waste certificate as well).

5. <u>Collaboration</u>

Regarding to Section 2.4.3 about supply chain resilience practices and processes, it can be found that collaboration is one of practice that was focused and studied as a practice of SRES in the existing literature. Then, collaboration in this stage means the ability to work effectively with other entities for mutual benefit, with some sub-factors such as communicators, risk-sharing with partners and product life cycle management (Pettit et al., 2010). All companies explained this activity in the same way, as the company having to contact and communicate with suppliers/customers to prepare and develop their supply chain, and also to communicate and review their policy within the company and with employees as well. As Company A stated, “the company will communicate with suppliers of major companies. For essential products that cannot be lacking/out-of-stock from the production and will monitor the production to be able to deliver on time”. Moreover, Company B mentioned, “collaborations are important when unforeseen disruptions happen, because it cannot do the process with our production but the company needs cooperation with suppliers and customers. It requires collaboration with the development partnership in operation”. Furthermore, Company D thought that the company, suppliers and customers should discuss requirement by sharing their concepts with others in order to work together effectively. Moreover, Company C highlighted that “collaboration within the company is quite a lot, and the company needs to improve collaboration with suppliers to work together to support customers’ requirements together”. However, Company E explained, “the company has

collaboration with customers by providing assistance and then the company and customers will find an alternative as most suitable together".

6. Recovery

According to the main purpose for SRES concept is how to survive in the disruption period?, so it can be found that recovery practice has received high interested in the literature. As mentioned in Section 2.10.3, recovery practice has a potential influence to increase organizational performance so this practice is important for all company in Phase One. So recovery in this thesis refers to the ability to return to normal operational state rapidly, with sub-factors such as crisis management, resource mobilization and communication strategy (Pettit et al., 2010). Most of the companies from Phase One had plans and procedures for dealing with their suppliers/customers during periods of disruption. For instance, Company C confirmed, "the company will check back with suppliers about when they are able to procure for the company. The company will prepare to resume production work as normal as possible". Moreover, Company C stated, "the company will involve cooperation in resolving the issue by planning activity between suppliers/customers together, for more efficiency". However, Company D thought, "it less impact for customers but more impact for suppliers, because the company should receive an up-to-date plan all the time (or sometimes that plan has changed)". Meanwhile, Company E explained, "the company will share their plan with the customers when the disruptions are coming, the company will recover and return to the original point". Furthermore, Company A stated that the company would appoint a functionary in various departments, and that the person who had responsibility for each function would manage and control the process during unusual circumstances. After that, the company would plan recovery time with suppliers/customers when possible (there should be a plan to return to normal practice as soon as it can be resumed).

7. External pressure

External pressure can be defined as influences, not specifically targeting the firm, which create business constraints or barriers, including social/cultural change,

political/regulatory change and competitive innovation (Pettit et al., 2010). This practice can be applied in a company to avoid outside problems. Most of the companies had experienced external pressure, i.e. governmental, non-governmental organizations, or social. This practice was explained in Phase One. As Company D said, “the impact from Government is taxes on products; however, most BOI policies impact on production/company procedure but do not support production easily enough”. Moreover, Company B also explained that the regulations imposed by BOI/Customs are often inflexible. This makes it difficult to do business, as well as imposing functional limitations on a company. Government regulation should be pursued in parallel with the business, in order to make the business more efficient. Moreover, Company F confirmed from his experience that there can be impact from regulations outside the company. This may be direct impact, but perhaps not a direct hit. Furthermore, a quarter of interviewees mentioned external pressure from customers, Company E stating that there were impacts from customers, such as the company needing to have ISO, TAPA (Security) because some customers preferred these standards, depending on the quality of their assessment. Furthermore, Company A explained, “most external pressures are from the customers, when disruptions happens, the customers will ask to the company about their plan and delivery time for their product. The company will support customers by providing the information”. An example of external pressure is when a multinational company needs to follow the mother country’s policy and manufacturer’s policy, as explained by Company B: “due to the company being a multinational company, the company needs to follow US laws and Thai laws about labour laws. Most of policies need to follow with provision of BOI Thailand in terms of working and import-export criteria as well”. Thus, this result from Phase One related to the studied by Pettit et al. (2013) that mentioned as “it was found that external pressures and connectivity are the highest vulnerabilities facing this diverse group of companies” (p.57). Therefore, this practice was focused and adopted by companies related to legislation of the government.

8. **Connectivity**

For the last practice of SResSCM practices in this thesis, connectivity was received an interesting from company as same as other practices. This practice is similar to collaboration; however, this word means degree of interdependence and reliance on outside entities. Sub-factors in this context are scales of network, degree of outsourcing, import and export channels, and reliance upon specialty sources (Pettit et al., 2010). However, all companies explained connectivity as the linkage between supplier/company/customer as follows: Company E mentioned that it appeared to be the connection between company and customers based on the delivery of products. With electrical, electronic and automotive products, when customers need the product suddenly, the company has to honour their requirement as soon as possible. So customers suggested HUB/distribution centres for each area of the company, which will be able to fulfil urgent demands more efficiently. Furthermore, Company A explained connectivity as "the company links all functions such as suppliers/customers together. When disruptions happen, the company will discuss with suppliers/customers to find out the best solutions, and also update the information between the supply chain". Moreover, Company B highlighted that, according to company procedure, customers could audit the suppliers if they wanted. Customers could also deliver their raw materials to suppliers directly for their products. This is a regulation that allowed customers contact with suppliers. This is similar to a comment from Company C that "suppliers will receive customer information to support the company's requirement".

4.7 Summary of SResSCM practices from Phase One

All interviewees in Phase One were questions to link the relation between SSCM practices and SRES practices as presented in Table 4.2. To summarize these relationships, the symbols for definition are as provided follow:

A – sustainable practices have a positive impact on resilience practices only

B – resilient practices have a positive impact on sustainable practices only

C – sustainable practices and resilient practices are related together

D – sustainable practices and resilient practices are unrelated together

Consequently, the results from Phase One appear in the table below.

Table 4.2: The relationship between SSCM practices and SRES practices

Resilient / Sustainable	Collaboration	Recovery	External pressure	Connectivity
Eco-design	C	D	C	C
Green production	C	C	C	C
Social responsibility	C	D	C	C
Investment recovery	C	C	C	C

Interviewees decided about these relationships by themselves. After that the researcher summarized the findings by finding the average symbols from all interviewees. As demonstrated in Table 4.2, the results show that most of the practices between SSCM and SRES are related. However, there are two relationships, which are unrelated, being ECO-design and Recovery, and Social Responsibility and Recovery. As mentioned by some companies, when disruptions occur, the company or supply chains will not pay attention to ECO-design, because the company needs to recover its production or process as soon as possible. Once the disruption is over, the company will return to focusing on ECO-design. Furthermore, as most interviewees explained, the company needs to recover itself first, and then support its neighbours later. Therefore, the company will not focus on social responsibility during the recovery process.

Lastly, the results from Phase One concerning SSCM practices and SRES practices, which were applied by the companies, and the performance measurement indicators related to SSCM and SRES performance are illustrated in Table 4.3.

Table 4.3: The level of SResSCM implementation for each company

Company	Interviewees	Sustainable supply chain management				Supply chain resilience management				Performance measurement
		ECO-Design	Green production	Social responsibility	Investment recovery	Collaboration	Recovery	External pressure	Connectivity	
Company A	Interviewee 1	◖	●	●	●	●	●	●	●	On time delivery (OTD)
Company B	Interviewee 2 Interviewee 3 Interviewee 4	●	●	●	●	●	●	●	●	ISO certificate, On time delivery (OTD), Product quality, Return of Investment (ROI), Power consumption, Wastewater discharge, Workers welfare and health, pollution control, Good relationship with surrounding, neighbourhood, Customer satisfaction, CO_2 emission control
Company C	Interviewee 5 Interviewee 6	◖	●	◖	●	●	●	●	●	Query-Cost-Delivery-Service (QCDS) Percentage of cost reduction Waste disposal correctly, control chemical waste
Company D	Interviewee 7	◖	◖	●	◖	●	◖	◖	○	Cost, Delivery, Quality, Service, and Flexibility Up-to-date plan for unforeseen disruptions On time delivery (OTD)
Company E	Interviewee 8	●	●	●	◖	●	●	●	◖	Energy saving, reused paper, internal competition Solar cell installation in WH
Company F	Interviewee 9	○	◖	○	○	●	◖	◖	○	Customer satisfaction

Note: ○ means considering implementing this practice; ◖ means partial implementation of this practice; ● means full implementation of this practice

Table 4.3 presents the current implementation level of SResSCM practices for each company. The findings showed that most of companies implemented these practices in their companies already. However, there is only one company fully implemented these practices in company as Company B. In addition, Company A, C and E also nearly implemented all of these practices in their company, it might be related to the natural of their products that cannot fully implemented these practices in company. While, Company D has some partial implementation of these practices, it might be because Company D does not has their own production so they cannot fully control their procedures and processes but they can implement some practices to their contact manufacturer. Finally, Company F has implemented less SResSCM practices than other companies; it might be Company F provides transportation to their customers only so they do not pay attention on some practices, which are related to production or process in company, and they might focus on customer satisfaction and low operational cost rather than other aspects. However, while discussing with Company F, the interviewee argued that his company will implement SSCM/SRES policy that really important in the future soon. Thus, SSCM and SRES concept are used widely at this moment and there will be improved to be better than before in the future.

Furthermore, in SResSCM practices, the findings showed that SRES practices (17 full implementation, 5 partial implementation and 2 considering implementing) were implemented in company more than SSCM practices (13 full implementation, 8 partial implementation and 3 considering implementing). This reason it should be that all of these companies have same experiences about the event of closed Suvarnabhumi Airport in 2008 and the huge flooding 2011 in Thailand so after that period, most companies aware and prepare for further disruptions in the future. Moreover, performance measurements from each company are varying. However, it can be found that most of them are interesting in on time delivery, cost reduction and customer satisfaction. Therefore, SResSCM practices from this thesis will help company to improve these performances.

4.8 Interesting issues from Phase One

Having reviewed Phase One data analysis, there were some essential points about the importance of SSCM and SRES for a company as follows:

1. The company should have a clear policy on SSCM and SRES, because, once the policy is employed by the company, employees will be aware of their responsibility, and the company will earn more benefits from SSCM and SRES. Moreover, some companies had plans to improve and implement sustainability and resilience policies in the future, so this might be a good sign for business trends to come.
2. The company should prepare more than one source of suppliers/3PLs for unforeseen disruptions, but does not need to prepare more than they need. Moreover, the supply chain should share their plans with each other, because SRES will be better when it is used right along the supply chain. The company can enhance their production by being strong and increasing the confidence of customers.
3. The important thing about SSCM and SRES in a company is that it has suppliers/customers as valued partners, who will do business with the company for a long time, and it can help suppliers to be more sustainable and resilient in the future.
4. Definitions of SSCM tend to be more environmental in perspective than other aspects (rather than economic and social aspects), so the company should provide for all employees to be clearly aware about the concept of SSCM in their company.
5. Definitions of SRES in Thailand's electrical and electronic industry are still lacking, but when the participants received more details of SRES definitions, they understood about SRES. However there might be different methods to describe supply chain resilience (most of them call it Contingency Plan), so the company might study SRES in more detail in order to improve resilience in the future.

6. New definitions of SResSCM still need to be investigated and developed by researcher, because the results concerning the relations between SSCM and SRES are still unclear at this time.
7. Performance measurement is normally used to measure On-time delivery (OTD), production output, waste from each stage, or cost saving, so the researcher need to develop a method of measurement that can measure and suggest how companies can develop their process to be more sustainable and resilient in the future.
8. The impact of SSCM on the company is that it will have more processes and procedures in production and also increased tasks for suppliers/customers.
9. The impact of SRES on the company is that it will have a contingency plan to use in unforeseen disruptions, with high performance and collaboration with suppliers/customers. It will also help the company to execute their business with more resilience in their partnership.

Regarding these issues from Phase One, the researcher concluded that practitioners also agree that there is a relationship between SSCM and SRES in company. Moreover, it can be found that SResSCM practices from the existing literature are implemented in the company already. However, there are not clear definitions of SSCM and SRES in practitioners' perspective but they also have SSCM and SRES practices in their company. Thus, the clear definition of SResSCM will support company in Thailand to improve their performance in term of sustainable and resilience in supply chains in the future, which related to RQ1 and RQ2. Furthermore, these findings also support the researcher to develop the implementation level measurement scale of SResSCM practices, which will measure the current SResSCM practices implemented and it will guide company to implement some practices that company does not implemented yet (which related to RQ3 and RQ4). The next section will provide the development of questionnaire protocol for this thesis.

4.9 Development of the questionnaire protocol for survey

Phase One supported the researcher to conclude from the information in the literature and from the practitioner's perspective about the SSCM and SRES fields, and to help develop SResSCM definitions and practices. Moreover, Phase One also provided essential insights on performance measurement of SResSCM practices on organizational performance and supply chain performance, which were the goals of this study.

The results show that companies need to study and announce explicit policies on SSCM and SRES (or contingency plans), because many employees are not aware of these policies. They could impact on a company's goals to become more sustainable or resilient. Management teams should ensure that they have the same direction in SSCM and SRES as their suppliers/customers, in order to maintain their business partnerships.

Furthermore, the definition of SSCM and SRES is still unclear in the electrical and electronic industry in Thailand. Thus the Thai Government could support all companies concerning this global business trend by increasing their knowledge and desire to become more sustainable and resilient. Moreover, companies should define SResSCM to enhance the understanding of their employees, who should know about their actions and roles in the supply chain.

In addition, measurement tools of SResSCM need to focus on both sustainability and resilience, because the results showed that all companies thought there was a mutual relationship between them. However, companies should balance SSCM and SRES together to achieve greater efficiency and effectiveness.

Consequently, the results from Phase One confirm that SSCM practices and SRES practices support each other to improve sustainability and resilience in companies. To summarize the data collection and analysis, a valid measurement scale of SResSCM for this thesis should be as follows:

1. The measurement should be based on tangible, measurable factors, because if factors cannot be measured, it might be useless to investigate them.
2. The measurement factors need to measure using scales (0, 1, 2, 3…) rather than digital (0 or 1), in order to guard against unfair measurement and to improve the level of scale.
3. As presented in Section 2.10.1, this thesis would like to study the relationship between SSCM and SRES as H_1. So the researcher applied 5-point Likert's scale to question respondents about this relationship. These scales comprise with "1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree" for the relations between SSCM and SRES, SSCM and SResSCM, SRES and SResSCM as presented in Table 4.4
4. According to Section 2.10.2 and 2.10.3, this thesis applied the existing measurement scales with 5-point Likert's scale from Green et al. (2012) as "1 = not considering; 2 = planning to consider; 3 = considering it currently; 4 = initiating implementation and 5 = implementing successfully". In addition, the researcher also provided the option as "Do not know" within this measurement scale because SSCM and SRES field are widely used in company, the respondents in the survey might not answer all questions. Moreover, sub-level for each practice was derived from Phase One and the relevant literature, therefore, it requires to use a large number of sample size to test for statistical significance in a populations for test H_2 and H_3. Thus, the implementation level measurement scale of eight practices might be scale, (see Table 4.5.).
5. As presented in Table 4.6, the measurement for supply chain performance should employ 5-point Likert's scale with the perception of practitioners ranging between "1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree" in relation to SResSCM practices that were implemented by companies, and which help to improve these performances. Regarding to Section 2.10.4, this thesis focuses supply chain performance on four constructs, i.e. operational cost, business wastage, environmental cost and customer satisfaction (Govindan et al., 2015). So the

researcher applied the measurement scale from Green et al. (2008); Govindan et al. (2015); Zhu et al. (2008) with Phase One findings about supply chain performance. This table will use to test H_4

6. On the other hand, regarding to Section 2.10.4 and testing for H_5 and H_6, the researcher applied measurement scale for short-term and long-term organization performance from Green et al. (2012); Li et al. (2006); Zhu et al. (2008) with Phase One findings about organizational performance. The measurement for organization performance was applied with 5-point Likert's scale as well, with related to perception from respondents about SResSCM practices and organization impact for short-term (less than 3 years) and long-term (more than 3 years). The scale for SResSCM practices impact in organization was "1 = no impact; 2= low impact; 3 = medium impact; 4 = high impact and 5 = extremely high impact" (as presented in Table 4.7); while the scale of organization performance impact was "1 = very low; 2 = low; 3 = moderate; 4 = high and 5 = very high" (as presented in Table 4.8).

Table 4.4: Measurement scale for the relationships

SResSCM relationships	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
SSCM → SRES	1	2	3	4	5
SRES → SSCM	1	2	3	4	5
SSCM → SResSCM	1	2	3	4	5
SRES → SResSCM	1	2	3	4	5

Table 4.5: Measurement scale for SResSCM practices implementation level

Practices	Items	Company's level					
		Do not know	Not considering	Planning to consider	Considering it currently	Initiating implementation	Implementing successfully
ECO-design	The company adopted environmental concerns when designing their products/processes						
	The company designs products that can be re-used and recycled						
	The company designs products that focus on the reduction of resource consumption and waste generation in product usage						
Green production	Green purchasing in the company purchases products that are more environmentally friendly						
	Green production in the company has a low resource consumption						
	Green warehouse and transportation in the company has the ability to reduce waste and carbon emissions to the environment						
Social responsibility	The company has well-defined social responsibility practices and has some good activities for local neighbourhoods						
	The company follows basic requirements of the department of labour for providing welfare and safety for employees						
	The company has a programme to develop their employees and provides more academic than business internships						
Investment recovery	The company sells scrap and used materials to certified waste disposal companies						
	The company audits their waste disposal companies to ensure it processes waste correctly						
	The company uses the policy of Board of Investment (BOI), Thailand as procedures for waste disposal						
Collaboration	The company effectively employs collaborative demand forecasting techniques by using shared data						
	The company's customers are willing to delay orders when the company's production capacity is hampered						
	The company communicates important information to their suppliers and customers for unforeseen disruptions						
Recovery	The company can quickly provide a formal response team of key personnel, both on-site and at corporate level						
	The company takes immediate action to mitigate the effects of disruptions, despite the short-term costs						
	The company has a contingency plan for unforeseen disruptions						
External pressure	The company follows Government/BOI legislation to conduct business using tax, or import-export criteria						
	The company implements basic requirements that customers request						
	The company uses customer feedback to develop their products/productions						
Connectivity	The company outsources operations to various suppliers						
	The company has the same standard within its supply chains as ISO14001 (linkage between suppliers-manufacturers-customers)						
	The company's suppliers receive information about customer requirements to support the production in the company						

Table 4.6: Measurement scale for Supply Chain Performance

Supply Chain Performance	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Operational cost	1	2	3	4	5
Business wastage	1	2	3	4	5
Environmental cost	1	2	3	4	5
Customer satisfaction	1	2	3	4	5

Table 4.7: Measurement scale for SResSCM practices impact

SResSCM practices impact	Short-term impact and Long-term impact				
	No impact	Low impact	Medium impact	High impact	Extremely high impact
Eco-design	1	2	3	4	5
Green production	1	2	3	4	5
Social responsibility	1	2	3	4	5
Investment recovery	1	2	3	4	5
Collaboration	1	2	3	4	5
Recovery	1	2	3	4	5
External pressure	1	2	3	4	5
Connectivity	1	2	3	4	5

Table 4.8: Measurement scale for organization performance

Organization's performance	Short-term impact and Long-term impact				
	Very low	Low	Moderate	High	Very high
Average return on investment	1	2	3	4	5
Average profit	1	2	3	4	5
Profit growth	1	2	3	4	5
Average return on sales	1	2	3	4	5
Average market share growth	1	2	3	4	5
Average sales volume growth	1	2	3	4	5
Average sales (in Thai Baht) growth	1	2	3	4	5
Average overall competitive position	1	2	3	4	5

4.10 Summary of Chapter

This chapter has shown the results from Phase One of this thesis research process with content analysis. It has summarized the information from participants to construct survey testing in the next step. Moreover, it has also described the relationship between SSCM and SRES from the practitioner's to the academic point of view, applying eight factors of SResSCM practice. These measurement tools will be tested in the survey (online, with attached file) with a sample of respondents to fully understand and empirically answer RQ1 through to RQ4. The next chapter will explain the results from Phase Two: Survey analysis and results.

Chapter 5 PHASE TWO: SURVEY ANALYSIS AND RESULTS

5.1 Introduction

This chapter presents the findings from the survey (Phase Two) of this study. According to the previous chapter on a semi-structured interview (Phase One), the questionnaire was developed and collected data during April–July 2016 from Thailand's manufacturing industry, i.e. electrical, electronic and automotive sectors. The main objectives for this chapter were testing statistic data from the survey and then developing a structural equation model (SEM) to study the relationship between SResSCM constructs. This chapter will examine non-respond bias, common method bias, Cronbach's alpha, exploratory factor analysis and SEM model. Partial Least Square (PLS-SEM) was mentioned as path analysis and was employed to test the hypothesized relationships between the constructs, followed by hypotheses testing at the end of the chapter.

5.2 Data collection

After the Phase One findings were analysed questionnaire survey protocols were developed to test the practitioners' perspectives. As stated in chapter 3, certain techniques were used for this stage in the form of translation and back-translation process. Referring to chapter 4 about the development of the questionnaire protocol, there are four main sections for the survey: A) sustainable supply chain management and supply chain resilience management (Table 4.4); B) sustainable and resilient supply chain management practices (Table 4.5); C) sustainable and resilient supply chain management and supply chain performance (Table 4.6) and D) Short and long-term impact of sustainable and resilient supply chain management (Table 4.7 and 4.8).

The survey instrument was developed in both English and Thai and was pre-tested with managers in the Thai industry sectors in March 2016, with 12 respondents as detailed in chapter 3. Managers were requested to comment on the questionnaire regarding structure, readability, ambiguity and completeness. The final survey

instrument was developed combined with feedback received from the managers, which improved the clarity of the instrument. Finally, the scale purification was iterative throughout the empirical test. After modifying the questionnaires from the pre-test, the questionnaire was sent out to the sampling groups.

The organization lists from the Thai manufacturing sector were prepared from different databases, as explained in chapter 3. From these databases, there were 1,032 organizations in the electronic industry, 1,449 organizations in the electrical industry and 1,415 organizations in the automotive industry. The researcher made telephone calls to invite the organizations to participate in this survey. Some organizations were not reachable, listed or didn't exist any longer, while others rejected participation in the study for different reasons.

For example, one organization did not have a policy to participate in any survey, the top management of another organization were always busy so they would not have time to participate, or the management team were foreign, being Japanese, Chinese, or other, and could only do the survey in their own language.

All 1,263 remaining respondents across seven databases (408 electronic, 616 electrical and 239 automotive) received information via email from the researcher after contacting the organizations via telephone. The e-mail contained details of the survey, cover letter from Bangkok University in Thailand (supporter for the researcher), cover letter from the researcher, and attached files with two versions of the questionnaire (see APPENDIX E for email information). Within the email information, the researcher also provided the links for completing the survey online; there were two links, for the English version and the Thai version. This process was conducted between April and July 2016.

The self-administered questionnaire consists of five sections (Sections A to E in the questionnaire protocol), which were developed (as discussed in Section4.8) to measure the relationship between SSCM and SRES (Section A), SResSCM practices (Section B), supply chain performance (Section C), SResSCM impact (Section D) and

respondent and organization information (Section E). The explanation for each section in the questionnaire with the research objectives and research questions appears below in Table 5.1.

Table 5.1: Structure of the questionnaire protocols

Section	RO	RQ	H	Explanation
Section A	RO1	RQ1	H_1	The list of 4 questions about the definition of SSCM, SRES and SResSCM were asked to indicate on five-point Likert's scale (1 = strongly disagree, 5 = strongly agree). This section was used to review and examine the perspective of practitioners about SResSCM in their company.
Section B	RO1	RQ1 RQ2	H_2, H_3	The list of 28 different questions in SResSCM practices applied within the company. There are 6 choice with one for "do not know" option and a five-point Likert's scale to indicate the level of applied practices as 1 = "not considering", 2 = "planning to consider", 3 = considering it currently", 4 = "initiating implementation", and 5 = "implementing successfully".
Section C	RO2	RQ3	H_4	The list of 28 questions about supply chain performance in the company in term of operational cost, business wastage, environmental cost, and customer satisfaction to indicate with a five-point Likert's scale (1 = strongly disagree, 5 = strongly agree).
Section D	RO2	RQ4	H_5, H_6	The list of 16 questions for short-term impact and 16 questions for long-term impact in the company with SResSCM practices to indicate the impact on a five-point Likert's scale (1 = no impact, 5 = extremely high impact) and company's performance, i.e. average return on investment, profit growth, and average overall competitive position, on five-point Likert's scale (1 = low impact, 5 = very high impact).
Section E				The ten questions for respondent' profile and company's information. These questions were used to descriptive analysis of this study. Moreover, in the rest of the survey, the respondents can select to participate in structured-interview for the next step of this study or request a copy of the final paper once completed.

5.3 Data analysis

Referring to chapter 3, the data from this survey was analysed in different aspects, i.e. evaluation of bias, descriptive analysis, measures of constructs and assessment of the structural model. Hair et al. (2010) explain that "the measurement model represents the relationship between the manifest variables (measurable items) and the unobserved latent variables, while the structural model focuses on the

hypothesized relationship between the latent variables" (p.554-6). Further, there are two approaches to measure the parameters of structural equation models: (1) the covariance-based and (2) the variance-based approach. Covariance Based Structural Equation Modelling (CB-SEM) and Partial Least Squares (PLS) are thought to be supplementary rather than competitive methods (Wold, 1985).

The small sample size did not allow the use of structural equation modelling based on the covariance matrix such as covariance-based structural equation modelling (CB-SEM); therefore a path analysis with Partial Least Squares (PLS) was employed for this study. There are several judgments that support PLS-SEM more suitable for the data analysis in this thesis. Firstly, Hair et al. (2016) stated "in situations where theory is less developed, researchers should consider the use of PLS-SEM as an alternative approach to CB-SEM" (p.15). Thus, the objective of this thesis is to investigate the relationship between SSCM and SRES construct so it might useful to apply PLS-SEM as alternative approach. Secondly, regarding to SResSCM practices construct is a reflective-formative hierarchical component model, so PLS-SEM is more appropriate approach rather than CB-SEM because PLS can simply handle both formative and reflective measurement models (Hair et al., 2016). Thirdly, Hair et al. (2014) highlight CB-SEM and PLS-SEM can estimate models that using formative indicators; however PLS-SEM has acquired consideration support as the recommended method. Moreover, Hair et al. (2016) also stated that "when applying PLS-SEM, researchers also benefit from high efficiency in parameter estimation, which is manifested in the method's greater statistic power than of CB-SEM" (p.18). Finally, PLS-SEM can handle small sample size as Reinartz et al. (2009) mentioned that "PLS is its suitability for small sample sizes" (p.341). As same as the discussion by Hair et al. (2016) that "PLS-SEM works different from maximum likelihood-based CB-SEM, which requires normally distributed data and regression using sum scores, which assume normally distributed residuals, PLS-SEM makes no distributional assumptions (i.e. it is nonparametric)" (p.18). Consequently, PLS-SEM is more suitable than CB-SEM for this thesis.

The general rule of thumb according to appropriate sample sizes when using PLS is to multiply by ten the highest number between (1) the greater number of formative indicators for a block (a construct in the model) and (2) the greater number of paths leading to a dependent variable (Braunscheidel and Suresh, 2009; Chin and Newsted, 1999). In this study, the highest number of paths leading to a dependent variable was four constructs (i.e. SResSCM practices, short-term impact, long-term impact, and supply chain performance), which meant that a minimum sample size of 40 cases would be necessary. Moreover, the researcher used software G*power (Faul et al., 2007) to calculate possible (minimum) sample size for this study, as proposed by Cohen (1988) for the *F*-test, pertaining to the R^2 value for the endogenous constructs. For this study, the researcher employed a medium effect size (f^2 = 0.15) for six predictors, a significant level of 0.05 and a desired power of 0.80. It was found that the minimum sample required for the validity of this study would be about 98 responses. Consequently, the 113 fully completed respondents were sufficient enough in number for this study, achieved with the minimum number of respondents detailed by G*Power.

There were several reasons for applying PLS-SEM as most suitable for the data analysis:

1) PLS refers to a set of multiple regressions to forecast the presence of relationships in the structural model (Tenenhaus, 2008). It is an iterative algorithm that individually modifies the blocks of the measurement model and forecasts the path coefficients in the structural model.
2) PLS is described as a soft modelling approach, where no strong assumptions (with respect to distributions, sample size and measurement scale), are needed (Hair et al., 2016).
3) PLS evades a negative impact based on errors in modelling or item usage (Chin, 2010).
4) PLS is less concerned with the preciseness of parameter estimation and does not hold a belief in the idea of an underlying covariance based latent variables generating mechanism (Chin, 2010).

5) PLS avoids the two serious problems of factor indeterminacy and inadmissible solutions (Fornell and Bookstein, 1982).
6) PLS allows multiple measures of both dependent and independent variables (Chin, 1998).

The judgment on whether a construct is operationalized in a formative or reflective manner should be based on theoretical considerations (Hair et al., 2016). A formative specification, where the constructs are formed by their individual items, enables the emphasis of the individual measures to be indicated (Hair et al., 2016). The independent variables, i.e. SResSCM practices construct, are all specified formatively because the aim of this study is to identify the affinity of each measure. On the other hand, the dependent variables are reflective. For good model fit, the results require sufficiently high R^2 values, construct reliability and significant path coefficients (Chin, 1998).

Thus, a partial least square structural equation model (PLS-SEM) is the most suitable approach to test reliability and validity measurement and the structural model with the software package SmartPLS 3.0 (Hair et al., 2016; Ringle et al., 2005). This structural equation modelling software package is an application of the PLS method (Chin, 1998). The following section will explain in more detail the data analysis in the study.

5.3.1. Data examination

Hair et al. (2016) demonstrated that the data collection and examination stage are essential processes in the application of SEM, especially when researcher anticipate using SEM. In first-generation statistical methods, the general assumption is that the data are error free. Furthermore, in second-generation statistical methods, the measurement model stage seeks to analyse the error component of the data and remove it from the analysis (Hair et al., 2016). After the researcher has collected data using questionnaires, issues will emerge from the data collection, including

missing data, and suspicious response patterns, outliers and data distribution, as mentioned by Hair et al. (2010).

5.3.1.1 Missing data

The issue of missing data occurs when respondents either purposely or inadvertently fail to answer one or more question(s) (Hair et al., 2016). Hair et al. (2010) stated that "the missing data processes, particularly those based on actions by the respondent (i.e. non-response to a question or set of questions), are rarely known beforehand" (p.40). When the number of missing data on a questionnaire is more than 15%, the observation may be eliminated from the data file, even if the overall missing data on the questionnaire do not exceed 15% (Hair et al., 2016). The need to focus on the reasons for missing data comes from the fact that the researchers must understand the process leading to the missing data in order to select a suitable course of action (Hair et al., 2010). The increased use of online data collection approaches has reduced missing data, because it is possible to prevent respondents from going on to the next question if they do not answer a particular question (Hair et al., 2016). According to the data collected for this study, the method of online survey and attached questionnaire sent via email was applied, which was protected by the online command. However, the attached questionnaire via email still had missing data from some respondents, because they did not answer questions they did not know the answers to, or did not want to answer. In fact, in Section B of the questionnaire (see Appendix B), there was an option for respondents of "Do not know", so when the researcher coded this answer into the SPSS programme, this question would be treated as missing data.

Hair et al. (2016) suggested three ways to manage missing data in smartPLS3 as mean value replacement, casewise deletion (or listwise deletion) and pairwise deletion. Due to some indicators having missing values of more than 5% (missing value from 1.02% – 12.50 %), mean value replacement option is not suitable for this study. Moreover, casewise deletion would decrease the number of observations in the data set, so this option would systematically omit this group of respondents and therefore be likely to yield biased results (Hair et al., 2016). Therefore, the most

suitable option for this study was pairwise deletion, because this approach still calculates valid data in the model, and ignores missing data from each respondent. However, the analysis may be based on different sample size, which can bias the results (Hair et al., 2016).

5.3.1.2 Suspicious response patterns

Hair et al. (2016) suggested that before the analysis stage, researchers need to examine the response patterns. Straight-lining in the survey should be removed from the dataset. In this survey, the target group was the electrical, electronic and automotive industry in Thailand, so within the survey there was a question about the primary product of the respondent's organization. This was a screening question to prevent the above issue.

5.3.1.3 Outliers

Hair et al. (2010) define outliers as "the observations with a unique combination of characteristics identifiable as distinctly different from the other observations" (p.62). Outliers can occur when combinations of variable values are particularly rare (Hair et al., 2016). Outliers can be categorized into four classes regarding the source of uniqueness as a procedural error, an extraordinary event, extraordinary observations and observations that fall within the ordinary range of values on each of the variables (Hair et al., 2010). There are three types of outlier detections for all the variables: univeriate, bivariate and multivariate detection (Hair et al., 2010). These three processes will support the basis for the detection/retention decision (Hair et al., 2010).

Firstly, univariate detection is used to investigate the observations on each of the variables individually. When running the SPSS programme to review outliers from the survey, several cases were stated as outliers for multiple indicators. Outliers are the observations with standardized variables values exceeding ±2.5 on each of the variables (Hair et al., 2010). Secondly, bivariate detection used the scatterplots created for each of the independent variables with the dependent variable (Hair et al., 2010). Finally, multivariate detection was used to evaluate multivariate outliers

with the Mahalanobis D^2 measure. This study analysis evaluates the position of each observation compared with the centre of all observations on a set of variables. For this step, all the metric independent variables were used. According to low observations for this study, conservative levels of significance, as *p*-value = 0.005, used as threshold value for designation as an outlier, will be applied (Hair et al., 2010).

The multivariate detection method was employed for this study. The Mahalanobis D^2 values were calculated using SPSS software. The results are shown in Appendix F. Several cases in multiple detection method were identified as outliers for multiple constructs. The researchers then needed to re-examine the observations to gain better understanding of their uniqueness by using univariate detection method in order to examine the distribution of observations for each variable in the analysis (Hair et al., 2010). All results are presented in Appendix G. After reviewing the observations, the researcher retained all observations because the outliers' cases do not affect the differences on variables of this population. Moreover, Hair et al. (2010) suggested deletion of outliers could jeopardize the generalizability of the study, unless those outliers are clearly unusual and not representative of any segment of the population.

5.3.1.4 Data distribution

According to the nature of PLS-SEM, which is a non-parametric statistical method, it requires verification that the data are not too far from normal, as extremely non-normal data prove problematic on the assessment of the parameter's significances (Hair et al., 2016). As this study will calculate the statistic with bootstrapping, it decreases the likelihood that some relationships will be evaluated as significant (Hair et al., 2011; Henseler et al., 2009). As bootstrapping procedure performs fairly robustly when data are non-normal, these tests provide only limited guidance when deciding whether the data are too far from being normally distributed (Hair et al., 2016). Furthermore, Hair et al. (2016) suggested that the researchers should examine two measures of distributions, as skewness and kurtosis.

Whereas skewness assesses the extent to which a variable's distribution is symmetrical, kurtosis is a measure of whether the distribution is too peaked (Hair et al., 2016). A general guideline for skewness is "if the number is greater than +1 or lower than -1, this is an indication of skewed distribution; on the other hand, kurtosis's general guideline is that if the number is greater than +1, it means the distribution is too peaked, whereas if the number is less than -1 it means that the distribution is too flat" (p.61). Distributions exhibiting skewness and/or kurtosis that exceed these guidelines are considered non-normal (Hair et al., 2016).

The distribution analysis in Appendix H highlighted that the number of variables deviated from normal. There are some skewed data which means this study involved non-parametric descriptive statistics which did not assume a normal distribution (Pallant, 2016). Thus, it was possible to employ PLS-SEM, which related to a non-parametric bootstrap process to test the path coefficients with significances (Hair et al., 2016).

5.3.2. Assessment of biases

Data from the survey needs to assess biases. There are different methods to examine bias, i.e. non-response bias, common method variance, or a Harman's single factor. These methods are explained in more detail.

5.3.2.1 Non-response bias

According to the data analysis, 113 valid responses were tested for non-response bias. Berg (2005) explained that non-response bias means "the mistake one expects to make in estimating a population characteristic based on a sample of survey data in which, due to non-response, certain types of survey respondents are under-represented" (p.867). Non-response bias can be explained as differences among the results from people who respond to a survey and those from sampled individuals who did not respond in a way relevant to the study. Furthermore, low rates of non-response can have high impacts on survey results. Wagner and Kemmerling (2010)

demonstrated that normally there are four approaches to evaluate non-response bias as:

1) Comparison of responses between early respondents and late respondents.
2) Comparison between responses from respondents and responses from a random sample of non-respondents obtained after a pre cut-off date.
3) Comparison of responses with non-respondents on multiple characteristics (normally demographic).
4) Comparison of the demographics of respondents with those of the population.

Due to the limitations of the questionnaire survey distribution, comparison between early responses and late responses was employed to evaluate non-response bias in this study. Questionnaire data were entered into SPSS. All data were reviewed and examined to clean and reduce errors as far as possible (Hair et al., 2010). The researcher used time periods to divide these data into two groups as: (1) early responses for data sent before 27th May 2016 and (2) late responses for data collected from 27th May 2016 to the extended deadline (31st July 2016). The study used several waves for alerting respondents, i.e. 1st email, reminder email, extended email, final call, or telephone call to invite participants to take part in the study. There were 67 respondents who responded to the survey immediately, and 46 respondents who were assigned as late responses.

In this study, the Mann-Whitney U test was applied to compare the difference between the medians for each question for early responses and late responses, since the majority of the variables in this survey had non-normally distributed data. This test is the non-parametric alternative to the t-test for independent samples (Pallant, 2016). The Mann-Whitney U test converted the scores on the continuous variable to ranks across the two groups; in this case, each question was evaluated according to whether the ranks for the two groups differed significantly. Where the scores are converted to ranks, the actual distribution of the scores does not matter (Pallant, 2016). The Mann-Whitney U test results for this study suggests that there

was one question with statistical difference at the significance level of 0.05 (see Appendix I) between the medians of the two groups of respondents out of the 84 tested (see Section A to D in the questionnaire protocol). According to Armstrong and Overton (1977), it can be assumed that responses from respondents who answer the questionnaire late are likely to be similar to non-respondents. Therefore, in this thesis, it was found that there are no significant differences between the two groups of survey responses and thus non-responses bias does not exist.

5.3.2.2 Common method variance

According to the collected data from the survey with a single respondent in the same survey, common methods variance (CMV) can be a problem. To avoid this bias, there are procedures to control this error. Podsakoff et al. (2003) stated that statistic tests can be employed to measure or evaluate any possible problem of common method bias. There are some procedural methods that can be applied in a survey as follows:

1) Using upper level managers or leadership who have high relevant knowledge for the survey (Mitchell, 1994).
2) Applying of existing measurement items from previous related studies to ensure the quality of the scales (Lindell and Whitney, 2001).
3) Using collaborative translation to enhance comprehension of the scale development (Douglas and Craig, 2007; Podsakoff et al., 2003).
4) Assuring respondents of the confidentiality and anonymity of their responses (Fugate et al., 2009).
5) Dividing the measurement items of exogenous variables from those of the criterion (Podsakoff et al., 2003).

The important concern is that common bias might artificially inflate observed relationship between variables. Pre-phase, to minimize common method variance, the dependent variables were placed after the independent variables in the survey

instrument, which helped to diminish, if not avoid, the effect of consistency artefacts (Podsakoff et al., 2003). Post-phase, a Harman's single factor test was conducted (Harman, 1976). Thus, if common method variance existed, either a single factor would emerge from a factor analysis of all the questionnaire measurement items, or one general factor that accounted for the largest share of the variance would emerge. For this study, exploratory factor analysis was used to test for common method bias, which will be explained in the factor analysis section (Harman, 1976).

5.3.3. Descriptive analysis

The respondents for this study were based in the electrical, electronic and automotive industries in Thailand. The survey was sent to all possible respondents in these industries, some respondents receiving calls from the researcher to invite them to participate in the survey. Some organizations participated, and some organizations refused to participate in the survey for different reasons.

The overall information from the survey is explained in this section. Descriptive statistics encompassing data frequencies, means, standard deviations and some graphs were stated and summarized below.

5.3.3.1 Respondent demographics

There were 113 respondents from Thailand's electrical and electronic industry (n = 99) and automotive industry (n = 14) who took part in this survey. There was different demographic information from each respondent, for instance, job title, age of respondent, respondent's experience in the organization/industry, organization's main activity, organization's position in the supply chain, organization size and organization's region in Thailand. First of all, demographic information about job title was explained. There were different job titles, such as CEO, Managing Director, supply chain director, logistics manager and so forth. This thesis presents that 86% (n = 97) of these respondents were in managerial positions. Most respondents were Managing Directors (19.5%, n = 22), Operation

Managers (18%, n = 20), Purchasing Managers (8%, n = 9), Logistics Managers (7%, n = 8) and so on. However, there were other positions who participated in this survey, such as Administration Manager (4%, n = 4), HR manager (3% n = 3) or assistant general manager, export manager, IT manager, production planning manager, sales manager and so on. Most respondents were aged between 46–55 years old (38.1%), or 36–45 years old (28.3%), as presented in Figure 5.1. Furthermore, 55% were male (n = 62) while 45% were female (n = 51).

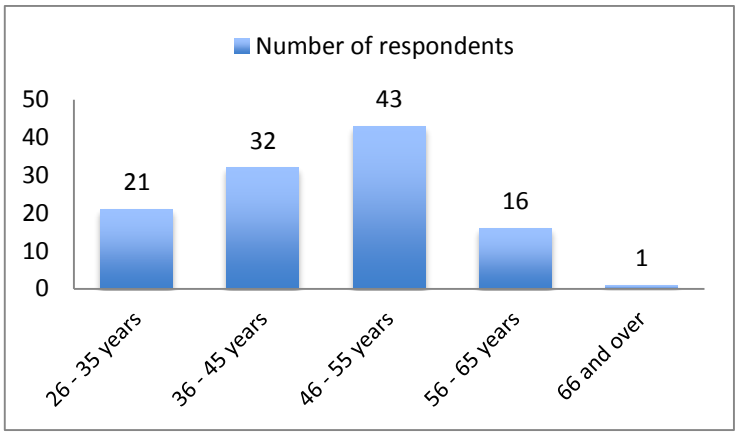

Figure 5.1: Respondents with age group

Figure 5.2 shows that nearly 50% of respondents had more than 10 years' experience in their organization (n = 55), and 23% had between 5 to 10 years (n = 23). Figure 5.3 states the amount of experience the respondents had in their industry. 56.6% of respondents had worked in their industry for more than 10 years (n =64), and 22% had worked in their industry for 5 to 10 years (n = 25).

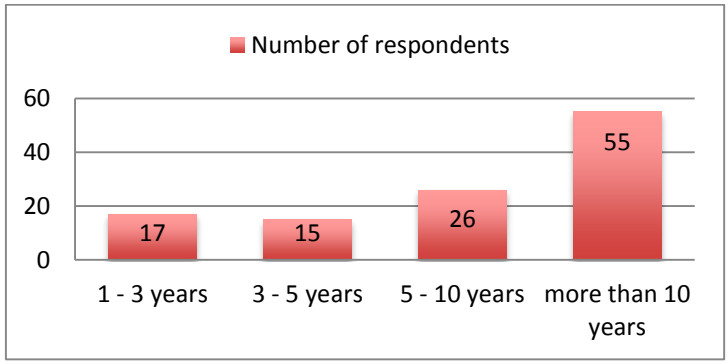

Figure 5.2: Respondents with experience in the organization

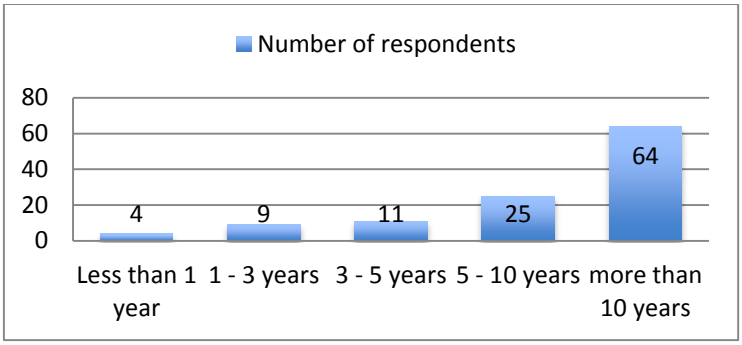

Figure 5.3: Respondents with experience in the industry

Moreover, Figure 5.4 explains the organizations' main activities from the survey. In electrical/electronic manufacturing (OEMs) there were about 48.7% (n = 55); electrical/electronic suppliers provided about 26.5% (n = 30); about 5% were from distributors (n = 6); 4% were from Automotive Manufacturing (n = 5); 9 respondents from Automotive suppliers (8%) and 1 respondent from automotive distribution. Furthermore, Figure 5.5 presents the organizations' relative positions in the supply chains. There were different positions, such as 4th-Tier supplier to 4th-Tier customer. Most respondents were suppliers, such as 1st-Tier suppliers, with 30% (n = 34); 2nd-Tier suppliers with 23% (n = 26) and 3rd-Tier suppliers with 13.3% (n = 15). There were some respondents from Focal firms, being 15% (n = 17), and some customers, about 19 respondents, from 1st-4th Tier Customers.

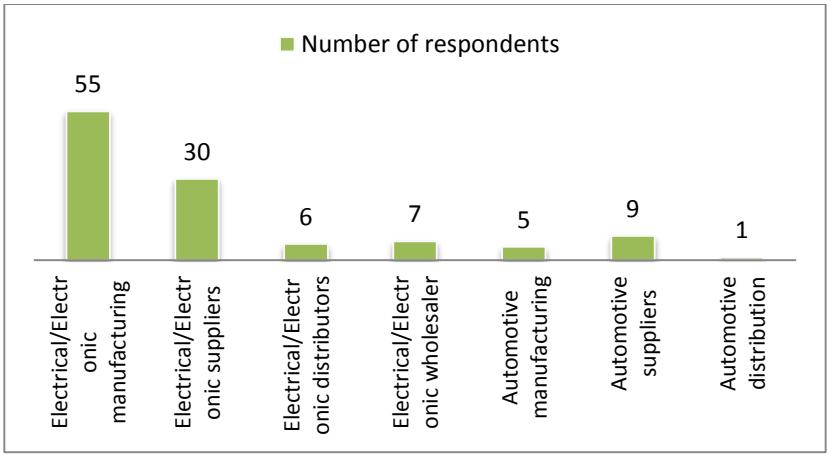

Figure 5.4: Respondents with organization's main activity

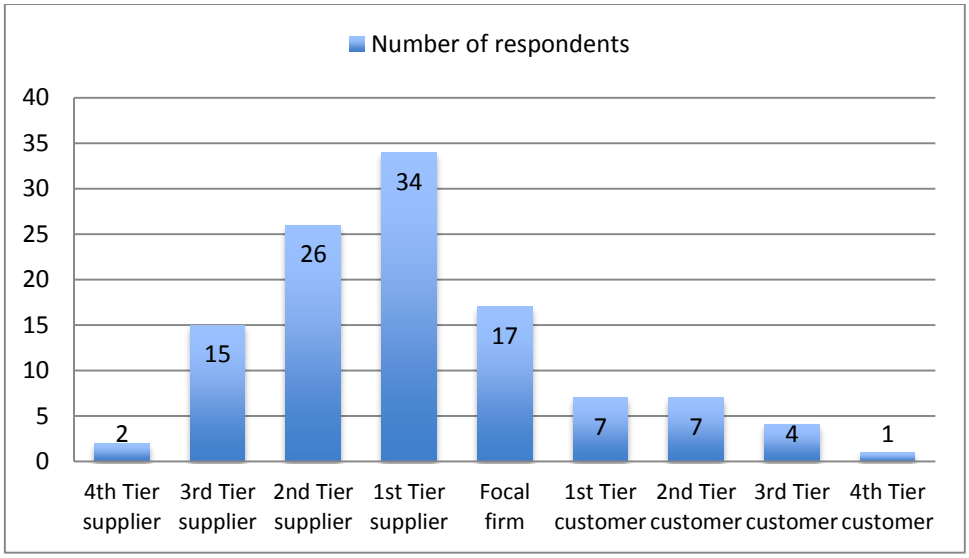

Figure 5.5: Respondents with organization's position in the supply chain

Figure 5.6 demonstrates the organizations' profiles in relation to annual revenue. There were four choices in this question. It can be seen that 48.7% of respondents had annual revenue of more than £4 million (200 million Baht), annual revenue between £1-£4 million, or annual revenue of less than £1 million, amounting to 15.9% (n = 18). However, some respondents selected "Would not answer this question", being 19.5% (n = 22). Moreover, Figure 5.7 shows the organizations' size related to the number of employees. Three organizations were small sized (up to 50 employees) (27%, n = 30), medium sized being 51-200 employees (21%, n = 24), and large sized being more than 200 employees (52%, n = 59) Finally, Figure 5.8 indicates the organizations' region in Thailand. 70% of respondents were in Bangkok and central Thailand (n = 79), 23 respondents were from the Eastern region, five respondents from the Northern region, and three from the Western and Northeast region. There were no organizations from the Southern region representing the electrical, electronic and automotive industries in Thailand.

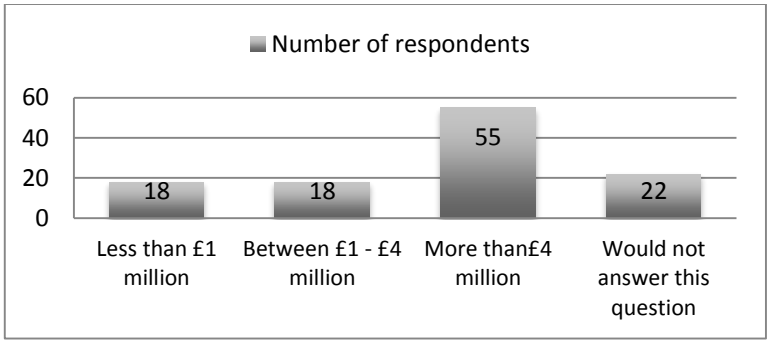

Figure 5.6: Respondents with organization's annual revenue

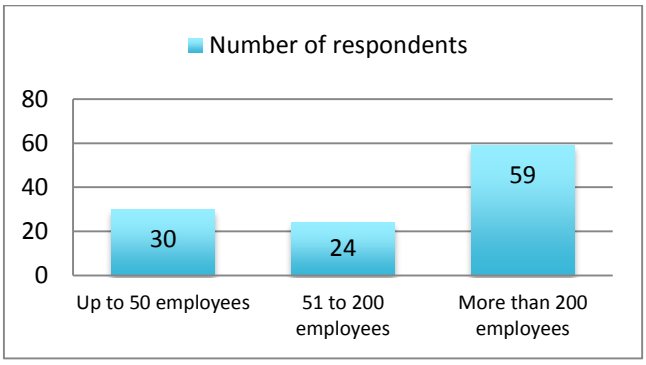

Figure 5.7: Organization size according to employee numbers

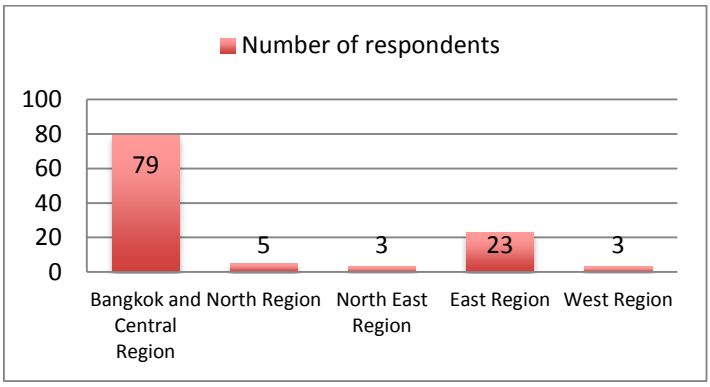

Figure 5.8: Respondents with organization's region

In summary, the profile of the respondents, in this survey, were mainly from managing director/ operation manager or manager position, with age between 46 – 55 years, working in large companies in Thailand with experience in their company and their industry more than 10 years. Most of respondents are in electrical/electronic manufacturing as 1-tier supplier, where most based on Bangkok and Central Region of Thailand. Thus, they are key and informed respondents for the survey who can provide a good answer for this survey.

5.3.3.2 Evaluation meaning for each questionnaire section

Respondents were asked about their perspective of SSCM, SRES and SResSCM in Section A, SResSCM practices in Section B, supply chain performance in Section C and SResSCM impact in Section D. This section will present results from the survey in Section A-D with descriptive analysis.

Section A: Sustainable supply chain management and supply chain resilience management definition

Regarding Chapter 2, research questions were developed and tested using practitioners from Thai industry. In this section, the respondents were asked about existing definitions of SSCM and SRES, and a new definition of SResSCM with their perceptions according to a five-point Likert's scale as "1 = strongly disagree and 5 = strongly agree". The means and standard deviation for these questions is shown in Table 5.2. It can be seen that all questions were answered with the "agree" option. Therefore, SSCM and SRES are clearly related and could be developed as SResSCM in the literature.

Table 5.2: Means, SD, and meaning for Section A questions

Items	Detail	Mean	Std. Deviation	Meaning
SSCM_01	Sustainable supply chain management supports the company to operate a supply chain resilience management	4.04	0.870	Agree
SRES_01	Supply chain resilience management supports the company to operate a sustainable supply chain management	4.12	0.765	Agree
SSCM_02	Sustainable supply chain management has a positive effect on sustainable and resilient supply chain management	4.16	0.727	Agree
SRES_02	Supply chain resilience management has a positive effect on sustainable and resilient supply chain management	4.11	0.760	Agree

Section B: SResSCM practices

The list of 24 questions for SResSCM were developed and asked of all respondents with a five-point Likert's scale as explained in Section 4.8. SResSCM practices were combined with four practices from SSCM: ECO-design (Choi and Hwang, 2015; Govindan et al., 2013; Karlsson and Luttropp, 2006; Kleindorfer et al.,

2005; Lai et al., 2008; Zutshi and Sohal, 2004), green production (Glavič and Lukman, 2007; Halme et al., 2002; Kjaerheim, 2005; Veleva et al., 2001), investment recovery (Chan et al., 2010; Choi and Hwang, 2015; Guide, 2000; Spicer and Johnson, 2004; Zhu et al., 2008) and social responsibility (Cruz and Wakolbinger, 2008; Govindan et al., 2013; Sarkis et al., 2010), and four practices from SRES: collaboration (Jüttner et al., 2010; Pettit et al., 2013), recovery (Pettit et al., 2010; Pettit et al., 2013), external pressure (Pettit et al., 2010; Pettit et al., 2013) and connectivity (Pettit et al., 2010; Pettit et al., 2013). The results for this section are stated in Table 5.3.

Table 5.3: Means, SD, and meaning for Section B questions

SResSCM practices	Items	Detail	Mean	SD	Meaning
ECO-design	ECO_01	The company adopted environmental concerns when designing their products/processes	3.60	1.340	Initiating implementation
	ECO_02	The company designs products that can be re-used and recycled	2.98	1.503	Considering it currently
	ECO_03	The company designs products that focus on the reduction of resource consumption and waste generation in product usage	3.79	1.187	Initiating implementation
Green Production	GREEN_01	Green purchasing in the company purchases products that are more environmentally friendly	3.68	1.297	Initiating implementation
	GREEN_02	Green production in the company has a low resource consumption	3.61	1.232	Initiating implementation
	GREEN_03	Green warehouse and transportation in the company has the ability to reduce waste and carbon emissions to the environment	3.63	1.166	Initiating implementation
Social Responsibility	SR_01	The company has well-defined social responsibility practices and has some good activities for local neighbourhoods	3.98	1.165	Initiating implementation
	SR_02	The company follows basic requirements of the department of labour for providing welfare and safety for employees	4.62	0.750	**Implementing successfully**
	SR_03	The company has a programme to develop their employees and provides more academic than business internships	3.11	1.462	Considering it currently
Investment Recovery	IR_01	The company sells scrap and used materials to certified waste disposal companies	4.46	1.106	**Implementing successfully**
	IR_02	The company audits their waste disposal companies to ensure it processes waste correctly	4.02	1.379	Initiating implementation
	IR_03	The company uses the policy of Board of Investment (BOI), Thailand as procedures for waste disposal	3.68	1.676	Initiating implementation
Collaboration	COL_01	The company effectively employs collaborative demand forecasting techniques by using shared data	3.57	1.434	Initiating implementation
	COL_02	The company's customers are willing to delay orders when the company's production capacity is hampered	3.15	1.622	Considering it currently
	COL_03	The company communicates important information to their suppliers and customers for unforeseen disruptions	3.88	1.332	Initiating implementation

Table 5.3: Means, SD and meaning for Section B questions (CONT)

Recovery	REC_01	The company can quickly provide a formal response team of key personnel, both on-site and at corporate level	4.33	1.047	**Implementing successfully**
	REC_02	The company takes immediate action to mitigate the effects of disruptions, despite the short-term costs	4.42	0.933	**Implementing successfully**
	REC_03	The company has a contingency plan for unforeseen disruptions	4.26	1.081	**Implementing successfully**
External pressure	EXT_01	The company follows Government/BOI legislation to conduct business using tax, or import-export criteria	4.50	0.955	**Implementing successfully**
	EXT_02	The company implements basic requirements that customers request	4.61	0.784	**Implementing successfully**
	EXT_03	The company uses customer feedback to develop their products/productions	4.46	0.900	**Implementing successfully**
Connectivity	CON_01	The company outsources operations to various suppliers	3.85	1.390	Initiating implementation
	CON_02	The company has the same standard within its supply chains as ISO14001 (linkage between suppliers-manufacturers-customers)	3.91	1.385	Initiating implementation
	CON_03	The company's suppliers receive information about customer requirements to support the production in the company	4.10	1.239	Initiating implementation

Section C: Supply Chain Performance

The lists of 24 questions were requested to rate the scale with a five-point Likert's scale from "1 = Strongly disagree and 5 = Strongly agree" in supply chain performance which the respondent's organization achieved during the past year. There were four terms of supply chain performance: operational cost (Jeffery et al., 2008), business wastage (Singh et al., 2010), environmental cost (Christiansen et al., 2003; Tsai and Hung, 2009; Zhu et al., 2005) and customer satisfaction (Beamon, 1999), which were applied from Green et al. (2012) and Govindan et al. (2015). The results from the survey are shown in Table 5.4.

Table 5.4: Means, SD, and meaning for Section C questions

Supply chain performance	Items	Detail	Mean	Std. Deviation	Meaning
Operational Cost	OPT_01	The company can decrease expenses of materials purchasing	4.21	0.725	Strongly Agree
	OPT_02	The company can decrease expenses on energy consumption	4.29	0.636	Strongly Agree
	OPT_03	The company can decrease fees for waste treatment	4.13	0.726	Agree
	OPT_04	The company can decrease inventory levels in their warehouse	4.15	0.782	Agree
	OPT_05	The company can decrease the cultural changes that have had significant impact	3.79	0.839	Agree
	OPT_06	The company can increase cooperation between suppliers/customers for green packaging	4.00	0.802	Agree
Business Wastage	BUS_01	The company can reduce air emissions	4.19	0.718	Agree
	BUS_02	The company can decrease consumption of hazardous materials	4.17	0.718	Agree
	BUS_03	The company can decrease scrap rate	4.15	0.770	Agree
	BUS_04	The company has increased production lines	3.89	0.838	Agree
	BUS_05	The company improved competitive innovation over competitors	4.04	0.749	Agree
	BUS_06	The company improved an enterprise's environmental situation	4.14	0.625	Agree
Environmental Cost	ENV_01	The company can decrease expenses for environmental accidents	4.06	0.698	Agree
	ENV_02	The company can decrease expenses for waste discharge	3.96	0.749	Agree
	ENV_03	The company can decrease effluent waste	3.98	0.779	Agree
	ENV_04	The company has increased number of certificated waste disposal lists	3.57	0.905	Agree
	ENV_05	The company has increased purchasing environmentally friendly goods	4.03	0.619	Agree
Customer Satisfaction	CS_01	The company increased the amount of goods delivered on time	4.25	0.726	Strongly Agree
	CS_02	The company increased a large number of members in supply chains	3.83	0.915	Agree
	CS_03	The company increased the outsourcing of materials by various suppliers	3.85	0.847	Agree
	CS_04	The company increased corporate social responsibility activities	3.83	0.767	Agree
	CS_05	The company increased product quality	4.21	0.700	Strongly Agree
	CS_06	The company improved an effective strategy for communications in a variety of extraordinary situations	4.12	0.670	Agree
	CS_07	The company improved capacity utilisation	4.30	0.565	Strongly Agree

Section D: Short- and long-term impact of SResSCM

For this section, respondents were asked about the impact of SResSCM practices in the short-term (0 – 3 years) and long-term (up to more than 3 years) to indicate their perceptions about SResSCM practices and organizations' performance (Li et al., 2006). They were asked to indicate the short and long-term impact of SResSCM practices with a five-point Likert's scale as "1 = No impact and 5 = Extremely high impact" as demonstrated in Table 5.5. Moreover, they were asked to rate the impact of organizations' performance with a five-point Likert's scale as "1 = Low impact and 5 = Very high impact" as shown in Table 5.6.

Table 5.5: Means, SD, and meaning for Section D: SResSCM practices

Items	Detail	Mean	Std. Deviation	Meaning
Short_01	Short-term impact on Eco-design	2.71	1.024	Medium impact
Short_02	Short-term impact on Green production	2.81	1.148	Medium impact
Short_03	Short-term impact on Social responsibility	2.80	1.240	Medium impact
Short_04	Short-term impact on Investment recovery	2.86	1.238	Medium impact
Short_05	Short-term impact on Collaboration	2.81	1.192	Medium impact
Short_06	Short-term impact on Recovery	2.86	1.093	Medium impact
Short_07	Short-term impact on External pressure	2.85	1.096	Medium impact
Short_08	Short-term impact on Connectivity	2.91	1.162	Medium impact
Long_01	Long-term impact on Eco-design	3.03	1.292	Medium impact
Long_02	Long-term impact on Green production	3.02	1.282	Medium impact
Long_03	Long-term impact on Social responsibility	3.03	1.306	Medium impact
Long_04	Long-term impact on Investment recovery	3.06	1.227	Medium impact
Long_05	Long-term impact on Collaboration	2.90	1.246	Medium impact
Long_06	Long-term impact on Recovery	2.98	1.157	Medium impact
Long_07	Long-term impact on External pressure	2.99	1.191	Medium impact
Long_08	Long-term impact on Connectivity	3.02	1.261	Medium impact

Table 5.6: Means, SD, and meaning for Section D: Organizational performance

Items	Detail	Mean	Std. Deviation	Meaning
Short_09	Short-term impact on Average return on investment	2.96	0.713	Moderate
Short_10	Short-term impact on Average profit	2.95	0.718	Moderate
Short_11	Short-term impact on Profit growth	3.00	0.763	Moderate
Short_12	Short-term impact on Average return on sales	2.95	0.693	Moderate
Short_13	Short-term impact on Average market share growth	3.04	0.738	Moderate
Short_14	Short-term impact on Average sales volume growth	3.03	0.792	Moderate
Short_15	Short-term impact on Average sales (in Thai Baht) growth	3.05	0.802	Moderate
Short_16	Short-term impact on Average overall competitive position	3.14	0.784	Moderate
Long_09	Long-term impact on Average return on investment	3.29	0.755	Moderate
Long_10	Long-term impact on Average profit	3.27	0.762	Moderate
Long_11	Long-term impact on Profit growth	3.23	0.817	Moderate
Long_12	Long-term impact on Average return on sales	3.27	0.820	Moderate
Long_13	Long-term impact on Average market share growth	3.30	0.804	Moderate
Long_14	Long-term impact on Average sales volume growth	3.30	0.827	Moderate
Long_15	Long-term impact on Average sales (in Thai Baht) growth	3.33	0.813	Moderate
Long_16	Long-term impact on Average overall competitive position	3.41	0.767	High

5.3.4. Measures of constructs

This study has used a quantitative survey with a structured questionnaire. To expand on the measurement items, there were some processes recommended by several authors in the literature, for instance Churchill (1979) and Anderson and Gerbing (1988), such as item generation through literature review, academic expert review, debriefing with industry experts, and item purification in the empirical study.

This section indicates the large-scale instrument validation result on each of the constructs with different processes, i.e. preliminary analyses for correlation, factor

analysis, measurement model and structural model. There were six main constructs: SSCM definition, SRES definition, SResSCM practices, supply chain performance, short-term impact and long-term impact.

The first step was preliminary analyses for correlation using nonparametric correlations for each construct from the SPSS programme. The second stage was to create constructs by using Exploratory Factor Analysis (EFA) from SPSS. The results from the EFA were subsequently employed in the last two stages to evaluate the reliability and validity of scales, variables and resultant constructs by using Partial Least Squares (PLS) analysis with smartPLS 3.0 programme. Once confidence had been obtained in relation to the validity and reliability of all of the items and constructs applied in this study, the structural model dimension of the PLS approach could later be attempted. Two-step stages were utilized in this section, as suggested by Hair et al. (2016). The first step consisted of the analysis of the measurement model, while the second step evaluated the structural relationship among the latent constructs. The two-step approach was aimed at formation of the reliability and validity of the measure before evaluating the structural relationship of the model (Hair et al., 2016).

5.3.4.1 Preliminary analyses for correlation

Correlation analysis is used to explain the strength and direction of the linear relationship between two variables (Pallant, 2016). Cohen (1988) suggested guidelines to interpret the values used to indicate the strength of the relationship between two variables, i.e. a correlation of 0.10 – 0.29 represents small strength, 0.30 – 0.49 mean medium strength, and 0.50 – 1.00 refers to large strength.

According to Table 5.7, the relation between six constructs, i.e. definition, practices and impact, were investigated using Pearson product-moment correlation coefficient. The results of the correlation analysis show a strong strength, positive correlation between SSCM definition and SRES definition with value 0.612, significance at $p<0.01$, and indicate 29.92% shared variance. Moreover, the

correlation between SResSCM practices and SCM performance had a strong positive correlation with values 0.566, n = 73, and significance at 0.01 (2-tailed). In addition, short-term impact and long-term impact also had a strong positive correlation between the two variables, r = 0.867, n = 113, p<0.01. Furthermore, other correlations were small and medium with values ranging from 0.004 to 0.321. Thus, the results about correlations between constructs led to the retaining of all independent variables.

Table 5.7: Correlations between constructs

Correlations	(1)	(2)	(3)	(4)	(5)	(6)
SSCM Definition (1)	1					
SRES Definition (2)	**0.547**	1				
SResSCM Practices (3)	0.129	0.004	1			
SCM Performance (4)	0.321	0.219	**0.566**	1		
SResSCM Short-impact (5)	0.291	0.236	0.172	0.170	1	
SResSCM Long-impact (6)	0.286	0.024	0.052	0.066	**0.867**	1

5.3.4.2 Factor analysis

Factor analysis is "can be utilized to examine the underlying patterns or relationships for a large number of variables and to determine whether the information can be condensed or summarized in a small set of factors or components" (p.89) (Hair et al., 2010). The measurement model assesses the relationship between measures and constructs by evaluating the validity and reliability of measurement models of the exogenous (independent) and endogenous (dependent) latent variables that were tested. Factor analysis can also be employed to decrease a large amount of related variables to a more manageable number prior to using them in other analyses, such as multiple regression or multivariate analysis of variance (Pallant, 2016). Factor analysis in the literature was described with two main approaches – exploratory and confirmatory. Exploratory factor analysis (EFA) is often used in the early stages of research to gather findings about the interrelationships among a set of variables (Pallant, 2016). On the other hand, confirmation factor analysis (CFA) can be used for theory building and

hypothesis testing (Hair et al., 2010). For this study, EFA technique was adapted and evaluated, as follows below.

For this section, the analysis started with purification, using reliability analysis and Corrected-item Total Correlation (CITC) analysis. The recommend initial analysis of a domain of variables is Exploratory Factor Analysis (EFA), therefore an EFA was subsequently conducted in an attempt to achieve data reduction, in that items that do not load properly are dropped and the instrument is thereby purified. The CITC for each item, its corresponding code name and Cronbach's alpha value for each dimension are shown in Appendix J.

Appendix J shows the CITC values for all items, most of which were well above 0.30, being the cut-off value suggested by Pallant (2016). The Cronbach's alpha were also well above 0.70 (ranging from 0.850 – 0.945), the minimum level required for an established construct. Consequently, it was decided to retain all items. An EFA was then conducted, using Principal Component Analysis (PCA) and Varimax as the method of rotation. A pooled-sample factor analysis for all items belonging to each of the SResSCM dimensions was performed. However, when the researcher checked for the number of survey respondents or cases for each variable, it could be seen that the ratio of respondents to items for all constructs was less than 5:1 or 10:1 (being about 113/84 = 1.35) from the literature (Hair et al., 2010; Nunnally, 1978), and thus did not meet the general guidelines. However, as mentioned before, this sample size was of sufficient quality when calculating the minimum sample with G*power technique.

Moreover, EFA also analysed the Kaiser Meyer Olkin (KMO) to assess sample adequacy (Kaiser, 1970, 1974). The KMO index ranged between 0 to 1, reaching one when each variables is perfectly predicted without error by the other variables, with 0.6 introduced as the minimum value for a good factor analysis (Tabachnick and Fidell, 2013). Bartlett's test of sphericity should be significant ($p< 0.05$) for the factor analysis to be considered appropriate (Pallant, 2016). Furthermore, communalities (h^2) is "total amount of variance an original variable shares with all other variables included in the analysis" (p.90) (Hair et al., 2010). Then, Hair et al.

(2010) suggested communalities (h^2) should be greater than 0.60 for most variables.

According to Hair et al. (2010), the guidelines for identifying significant factor loading are based on sample size, as shown in Table 5.8. So researcher need to determine the suitable factor loading to represent the correlation between an original variable and its factor. According to the respondents for this study, about 100-sample size, the significant factor loading applied in this thesis was 0.55 in order to conduct group analysis.

Table 5.8: Guidelines for identifying significant factor loadings based on sample size *(Source:* Hair et al. (2010), p.115*)*

Factor Loading	Sample Size Needed for Significance
0.30	350
0.35	250
0.40	200
0.45	140
0.50	120
0.55	**100**
0.60	85
0.65	70
0.70	60
0.75	50

EFA was employed to evaluate separately and in combination the differences and similarities from each variable, based on four main parts of the questionnaire, by conducting the classification of eight constructs, i.e. SResSCM definition, SResSCM practices and different impacts of SResSCM.

5.3.4.3 Sustainable and resilient supply chain management definition construct

Based on factor analysis for SResSCM definition, a pooled-sample was performed. The results from PCA with Varimax rotation show that the KMO measurement and Bartlett's test showed the adequacy of this construct (KMO = 0.699 (>0.6), and Bartlett's test significant at 0.000). There were also sufficient inter-item correlations

within the data for performing EFA and item communalities for SResSCM definition, as shown in Table 5.9.

Table 5.9: Exploratory analysis for SResSCM definition

Construct	Previous Items	Revised Items	Component	Communalities
			1	
Factor -1 SResSCMDef	SSCM_02	SRESSCM_01	0.907	0.752
	SRES_01	SRESSCM_02	0.867	0.823
	SRES_02	SRESSCM_03	0.851	0.724
	SSCM_01	SRESSCM_04	0.766	0.586
Eigenvalues			2.886	Cronbach's alpha = 0.864
% of variance			72.145	
Cumulative % of variance			72.145	

Based on Table 5.9, item SSCM_01 had communities' value below 0.6, and should be removed. However, anti-image correlation for item SSCM_01 was higher than 0.5, so the researcher retained this item in the factor analysis process. According to Kaiser's criterion, the component, which has an eigenvalue of 1 or more, emerged as 1 component only from this factor analysis. The component explains a total of 72.145% of the variance. Three items had communalities above 0.6, and all items loaded significantly on a single factor, with loadings above 0.55. However, the EFA resulted in a single construct, so it was decided to merge them into one component. Thus, this factor was renamed as "sustainable and resilient supply chain management definition" and coded as "SResSCMdef".

5.3.4.4 Sustainable and resilient supply chain management practices construct

SResSCM practices were initially developed consisting of eight practices and 24 items, including ECO-design (3 items), green production (3 items), social responsibility (3 items), investment recovery (3 items), collaboration (3 items), recovery (3 items), external pressure (3 items) and connectivity (3 items). A scale of 1 – 5 was applied to measure the level of applied practices within an organization. For each item, loadings of about 0.55 and above were deemed necessary. Thus, the items, which generated loading values less than the required 0.55, were removed from further analysis. As with the SResSCM practices construct, this construct was

also subjected to PCA with Varimax rotation, using SPSS. The results from the EFA process for this construct are shown in Table 5.10.

Table 5.10: Initial Factor Analysis for SResSCM practices

Constructs	Item	Component					Communities	Condition
		1	2	3	4	5		
Factor1	EXT_02	0.817					0.730	
	REC_01	0.811					0.791	
	EXT_01	0.806					0.778	
	REC_02	0.797					0.790	
	EXT_03	0.732					0.732	
	SR_02	0.712					0.643	
	REC_03	0.701					0.759	
	CON_03	0.626					0.767	
Factor2	ECO_02		0.813				0.731	
	ECO_03		0.775				0.724	
	ECO_01		0.713				0.678	
Factor3	CON_01			0.739			0.746	
	SR_03			0.727			0.652	
	CON_02			0.578			0.635	
Factor4	IR_02				0.820		0.842	
	IR_03				0.779		0.739	
	IR_01				0.582		0.745	
Factor5	COL_02					0.848	0.757	
	COL_03					0.635	0.679	
Removed	GREEN_01						0.485	Removed
	GREEN_02						0.540	Removed
	GREEN_03						0.571	Removed
	SR_01						0.661	Removed
	COL_01						0.575	Removed
Eigenvalues		11.12	1.97	1.44	1.17	1.05	Cronbach's alpha = 0.945	
% of variance		46.34	8.22	6.00	4.86	4.38		
Cumulative % of variance		46.34	54.55	60.55	65.41	69.78		

According to Table 5.10, the Kaiser-Meyer-Olkin value was 0.874, which exceeded the recommended value of 0.6, and the Bartlett's test had significant level at 0.000, supporting the factorability of the correlation matrix. Initial factor analysis representing these five items: GREEN_01, GREEN_02, GREEN_03, SR_01, and COL_01 had loading below the cut-off point (at 0.55 for this study) and these were removed. Then, the 19 remaining items were re-submitted to the PCA procedure with Varimax rotation. The iterative procedure continued with the deletion of SR_03, CON_01 and CON_02 due to item loading below 0.55. The final factor analysis is shown in Table 5.11.

Table 5.11: Final factor analysis for SResSCM practices

Constructs	Item	Component				Communities
		1	2	3	4	
Factor 1	EXT_02	0.842				0.749
	REC_02	0.840				0.78
	EXT_01	0.815				0.782
	REC_01	0.811				0.792
	EXT_03	0.768				0.695
	REC_03	0.725				0.754
	SR_02	0.690				0.611
	CON_03	0.688				0.743
Factor 2	IR_02		0.844			0.842
	IR_03		0.822			0.75
	IR_01		0.621			0.749
Factor 3	ECO_02			0.845		0.764
	ECO_03			0.792		0.738
	ECO_01			0.783		0.744
Factor 4	COL_02				0.895	0.838
	COL_03				0.677	0.714
Eigenvalues		8.13	1.70	1.16	1.07	Cronbach's alpha = 0.92
% of variance		50.80	10.59	7.22	6.67	
Cumulative % of variance		50.80	61.40	68.61	75.29	

Table 5.11 demonstrates all 16 remaining items loaded on their respective with average loading being about 0.8. The final factor analysis stated the presence of four components: IEP, IR, ECO and COL with eigenvalues exceeding 1, explaining 50.80%, 10.59%, 7.22% and 6.67% of the variance respectively, which accounted for 75.29% of the cumulative variance. Based on the factor analysis for SResSCM practices, the researcher need to revise the names of factors or constructs for this study, as Table 5.12.

Table 5.12: Names of Factors/Constructs for SResSCM practices

	Factor's name
Factor 1	Internal and external plan (IEP)
Factor 2	Investment Recovery (IR)*
Factor 3	ECO-design (ECO)*
Factor 4	Collaboration (COL)*

Note * name remains from the previous stage.

To generate the variable's name for the next process, the researcher need to revise variable name and variable code as presented in Table 5.13. The resulting 24

variables forming the original SResSCM practices are reduced to 16 variables: 8 variables for IEP construct, 3 variables for IR construct, 3 variables for ECO construct and 2 variables for COL construct.

Table 5.13: SResSCM Variable's name from EFA

Construct	Initial Variable	Revised Variable	Variable's definition
Internal and external plan (IEP)	EXT_02	IEP _01	The company implements basic requirements that customers request
	REC_02	IEP _02	The company takes immediate action to mitigate the effects of disruptions, despite the short-term costs
	EXT_01	IEP _03	The company follows Government/BOI legislation to conduct business using tax, or import-export criteria
	REC_01	IEP _04	The company can quickly provide a formal response team of key personnel, both on-site and at corporate level
	EXT_03	IEP _05	The company uses customer feedback to develop their products/productions
	REC_03	IEP _06	The company has a contingency plan for unforeseen disruptions
	SR_02	IEP _07	The company follows basic requirements of the department of labour for providing welfare and safety for employees
	CON_03	IEP _08	The company's suppliers receive information about customer requirements to support the production in the company
Investment Recovery (IR)	IR_02	IR_01	The company audits their waste disposal companies to ensure it processes waste correctly
	IR_03	IR_02	The company uses the policy of Board of Investment (BOI), Thailand as procedures for waste disposal
	IR_01	IR_03	The company sells scrap and used materials to certified waste disposal companies
ECO-design (ECO)	ECO_02	ECO_01	The company designs products that can be re-used and recycled
	ECO_03	ECO_02	The company designs products that focus on the reduction of resource consumption and waste generation in product usage
	ECO_01	ECO_03	The company adopted environmental concerns when designing their products/processes
Collaboration (COL)	COL_02	COL_01	The company's customers are willing to delay orders when the company's production capacity is hampered
	COL_03	COL_02	The company communicates important information to their suppliers and customers for unforeseen disruptions

5.3.4.5 Supply chain performance construct

Supply chain performance variables were initially presented with four dimensions and 24 items, encompassing operational cost (6 items), business wastage (6 items), environmental cost (5 items) and customer satisfaction (7 items). Likert's scale from 1 to 5 was applied to evaluate SCM performance measured against SResSCM practices applied in organizations. The loading for each variable was set at 0.55, the

same as the previous sub-section. Then, SCM performance construct was generated in SPSS with PCA and Varimax rotation.

Table 5.14: Initial factor analysis for SCM performance

Item	Component						Communalities	Condition
	1	2	3	4	5	6		
ENV_02	0.763						0.780	
OPT_03	0.761						0.685	
BUS_01	0.740						0.584	
ENV_03	0.720						0.731	
BUS_06	0.715						0.654	
CS_04	0.713						0.648	
OPT_06	0.690						0.573	
CS_01	0.685						0.686	
BUS_03	0.677						0.791	
BUS_02	0.674						0.699	
BUS_04	0.672						0.715	
OPT_01	0.672						0.642	
CS_06	0.651						0.612	
CS_07	0.648						0.775	
OPT_04	0.646						0.695	
OPT_02	0.635						0.637	
ENV_01	0.628						0.720	
CS_05	0.614						0.715	
CS_02	0.582						0.725	
CS_03	0.573						0.809	
ENV_05	0.550						0.777	
OPT_05							0.714	Removed
BUS_05							0.783	Removed
ENV_04							0.668	Removed
Eigenvalues	10.203	1.712	1.418	1.252	1.15	1.082	Cronbach's alpha = 0.938	
% of variance	42.511	7.133	5.908	5.215	4.793	4.509		
Cumulative % of variance	42.511	49.645	55.553	60.768	65.561	70.07		

Note: Table 5.14 shows loading over 0.55 only

According to Table 5.14, the KMO value, which exceeded the recommended value of 0.6, was 0.862, and the Bartlett's test had a significant level at 0.000. Moreover, item communalities were all above 0.6 with the mean communalities of 0.701. The initial factor analysis, as shown in Table 5.14, presented three items: OPT_05, BUS_05, and ENV_04 which had low loading (lower cut-off point at 0.55) and were then removed. The 21 remaining items were re-tested with factor analysis in SPSS until all items had loading above the cut-off. The iterative procedure continued with the deletion of OPT_03, OPT_06, BUS_01, BUS_06, ENV_05, and CS_04 due to item loading below 0.55. The final factor analysis is shown in Table 5.15.

Table 5.15: Final factor analysis for SCM performance

Construct	Item	Component				Communalities
		1	2	3	4	
Factor 1	CS_07	0.780				0.738
	OPT_02	0.764				0.639
	OPT_01	0.689				0.627
	CS_01	0.687				0.594
	OPT_04	0.678				0.579
	CS_06	0.560				0.635
Factor 2	ENV_02		0.823			0.820
	ENV_03		0.800			0.786
	BUS_04		0.733			0.717
	ENV_01		0.691			0.583
Factor 3	BUS_02			0.784		0.780
	CS_05			0.698		0.652
	BUS_03			0.672		0.695
Factor 4	CS_03				0.837	0.818
	CS_02				0.834	0.804
Eigenvalues		6.735	1.548	1.116	1.067	Cronbach's alpha = 0.909
% of variance		44.898	10.321	7.443	7.116	
Cumulative % of variance		44.898	55.218	62.661	69.777	

The final factor analysis for SCM performance in Table 5.15 showed all factors had loading greater than 0.55 and revealed the presence of four components: COC, ENV, BS, and CS with eigenvalues exceeding 1, explaining 44.89%, 10.32%, 7.44% and 7.11% respectively, which accounted for 69.77% of the cumulative variance. The KMO value was 0.861 and Bartlett's test had a significant level at 0.000. The average communalities were 0.70 with Cronbach's Alpha at 0.909. According to EFA process, the researcher needs to revise the name of construct from the EFA's result. Table 5.16 shows the name of the construct from EFA for SCM performance construct. Moreover, Table 5.17 presents the revised name of variables and revised name of code for this study as well.

Table 5.16: Names of Factors/Constructs for SCM performance

	Factor's name
Factor 1	Customer and operational cost (COC)
Factor 2	Environmental cost (ENV)*
Factor 3	Business Wastage (BUS)*
Factor 4	Customer Satisfaction (CS)*

Note * means remain from the previous stage.

Table 5.17: SCM performance Variable's name from EFA

Construct	Initial variable	Revised Variable	Variable's definition
Customer and operational cost (COC)	CS_07	COC_01	The company improved capacity utilisation
	OPT_02	COC_02	The company can decrease expenses on energy consumption
	OPT_01	COC_03	The company can decrease expenses of materials purchasing
	CS_01	COC_04	The company increased the amount of goods delivered on time
	OPT_04	COC_05	The company can decrease inventory levels in their warehouse
	CS_06	COC_06	The company improved an effective strategy for communications in a variety of extraordinary situations
Environmental cost (ENV)	ENV_02	ENV_01	The company can decrease expenses for waste discharge
	ENV_03	ENV_02	The company can decrease effluent waste
	BUS_04	ENV_03	The company has increased production lines
	ENV_01	ENV_04	The company can decrease expenses for environmental accidents
Business Wastage (BUS)	BUS_02	BUS_01	The company can decrease consumption of hazardous materials
	CS_05	BUS_02	The company increased product quality
	BUS_03	BUS_03	The company can decrease scrap rate
Customer Satisfaction (CS)	CS_03	CS_01	The company increased the outsourcing of materials by various suppliers
	CS_02	CS_02	The company increased a large number of members in supply chains

5.3.4.6 Sustainable and resilient supply chain management and its impact construct

The impact construct consists of SResSCM practices and organizational performance over different periods of time, i.e. short-term and long-term impact. 32 items were firstly subjected to PCA analysis with Varimax rotation. The results, as shown in Table 5.18, showed the KMO measurement of sample adequacy was 0.885 and the Bartlett's test had a significant level at 0.000. Items communalities had average value of about 0.794. Moreover, the average loading was 0.820 for each variable.

Table 5.18: Initial factor analysis for SResSCM impact

Construct	Item	Component				Communalities
		1	2	3	4	
Factor 1	Long_02	0.908				0.851
	Long_05	0.902				0.840
	Short_08	0.891				0.808
	Long_08	0.890				0.821
	Long_03	0.886				0.839
	Long_06	0.886				0.830
	Long_04	0.886				0.814
	Long_01	0.872				0.799
	Short_05	0.870				0.794
	Long_07	0.857				0.764
	Short_04	0.854				0.771
	Short_02	0.853				0.732
	Short_06	0.816				0.743
	Short_07	0.804				0.683
	Short_03	0.801				0.698
	Short_01	0.726				0.573
Factor 2	Long_11		0.838			0.896
	Long_13		0.835			0.872
	Long_14		0.818			0.862
	Long_10		0.804			0.885
	Long_12		0.803			0.833
	Long_09		0.800			0.836
	Long_15		0.777			0.846
	Long_16		0.676			0.664
Factor 3	Short_10			0.832		0.830
	Short_09			0.823		0.787
	Short_11			0.813		0.874
	Short_12			0.633		0.713
Factor 4	Short_15				0.816	0.887
	Short_14				0.815	0.856
	Short_13				0.771	0.782
	Short_16				0.668	0.633
Eigenvalues		15.141	6.721	2.043	1.512	Cronbach's alpha = 0.964
% of variance		47.315	21.002	6.384	4.724	
Cumulative % of variance		47.315	68.318	74.702	79.426	

As presented in Table 5.18, there were four components, with eigenvalues of more than 1, explaining 47,315%, 21.002%, 6.384%, and 4.724% respectively, which accounted for 79.426% of the cumulative variance. Thus, initial EFA results for this section presented appropriate components for SResSCM impact. However, the

researcher needs to revise the factor's name, as stated in Table 5.19, and revise the variable's name and variable's code, as presented in Table 5.20.

Table 5.19: Names of Factors/Constructs for SResSCM impact

	Factor's name
Factor 1	SResSCM practices impact (SRESPI)
Factor 2	Long-term Organization performance (LOP)
Factor 3	Short-term Financial (STF)
Factor 4	Short-term Growth (STG)

Table 5.20: SResSCM impact Variable's name from EFA

Construct	Initial variable	Revised Variable	Variable's definition
SResSCM practices impact (SRESPI)	Long_02	SRESPI_01	Long-term impact Green production
	Long_05	SRESPI_02	Long-term impact Collaboration
	Short_08	SRESPI_03	Short-term impact Connectivity
	Long_08	SRESPI_04	Long-term impact Connectivity
	Long_03	SRESPI_05	Long-term impact Social responsibility
	Long_06	SRESPI_06	Long-term impact Recovery
	Long_04	SRESPI_07	Long-term impact Investment recovery
	Long_01	SRESPI_08	Long-term impact Eco-design
	Short_05	SRESPI_09	Short-term impact Collaboration
	Long_07	SRESPI_10	Long-term impact External pressure
	Short_04	SRESPI_11	Short-term impact Investment recovery
	Short_02	SRESPI_12	Short-term impact Green production
	Short_06	SRESPI_13	Short-term impact Recovery
	Short_07	SRESPI_14	Short-term impact External pressure
	Short_03	SRESPI_15	Short-term impact Social responsibility
	Short_01	SRESPI_16	Short-term impact Eco-design
Long-term Organization performance (LOP)	Long_11	LOP_01	Long-term Profit growth
	Long_13	LOP_02	Long-term Average market share growth
	Long_14	LOP_03	Long-term Average sales volume growth
	Long_10	LOP_04	Long-term Average profit
	Long_12	LOP_05	Long-term Average return on sales
	Long_09	LOP_06	Long-term Average return on investment
	Long_15	LOP_07	Long-term Average sales (in Thai Baht) growth
	Long_16	LOP_08	Long-term Average overall competitive position
Short-term Financial (STF)	Short_10	STF_01	Short-term Average profit
	Short_09	STF_02	Short-term Average return on investment
	Short_11	STF_03	Short-term Profit growth
	Short_12	STF_04	Short-term Average return on sales
Short-term growth (STG)	Short_15	STG_01	Short-term Average sales (in Thai Baht) growth
	Short_14	STG_02	Short-term Average sales volume growth
	Short_13	STG_03	Short-term Average market share growth
	Short_16	STG_04	Short-term Average overall competitive position

5.3.5. Reconceptualised main study model with EFA process

After conducted EFA process, the conceptual model for this thesis was revised (Figure 5.9) before evaluation measurement model and structural model. All remaining variables from EFA process were assigned to relevant constructs in the conceptual model for this thesis.

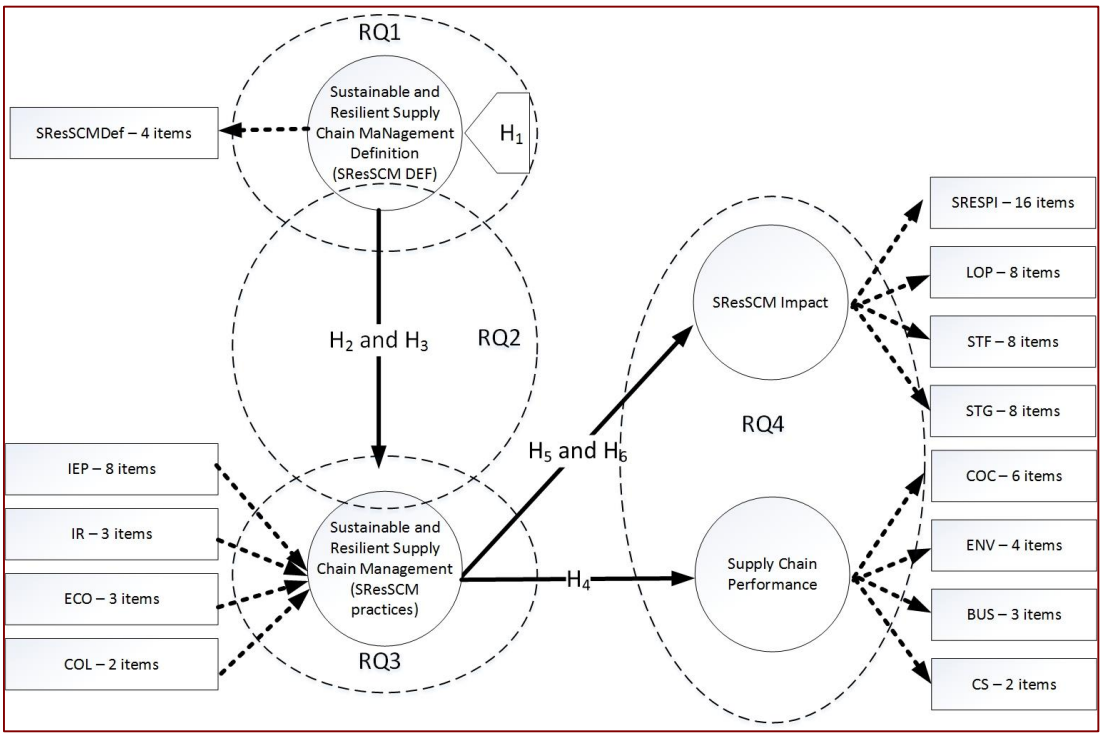

Figure 5.9: Revised conceptual model for main study

First of all, sustainable and resilient supply chain management definition (SResSCM Def) combined with the definition of SSCM and SRES, which related to RQ1 and H_1 for this study. It encompasses with four variables for this construct. Then, the definition of SSCM and SRES had linked to practices in organizations, which used to answer H_2 and H_3 and related to RQ2. After that, sustainable and resilient supply chain management practices consists of a repeated indicator approach with hierarchical latent variable models, i.e. IEP, IR, ECO and COL, which this construct will answer RQ3. Then, H_4 is remaining the same as former model but the variables for this construct were changed to COC, ENV, BUS and CS as presented before. Lastly, H_5 and H_6 were integrated together because short and long-term impact were merged into one construct after EFA process and all variables were renamed

as SRESPI, LOP, STF and STG. However, H_4, H_5 and H_6 were used to answer RQ4 as same as before. For this model, the researcher applied reflective-formative type models for SResSCM practices construct; while applied reflective-reflective type models for SResSCM impact construct and SC performance construct because the repeated indicator approach is its ability to estimate all constructs simultaneously instead of estimating lower-order and higher-order dimensions separately (Becker et al., 2012). The model with a repeated indicator approach as presented in Appendix M (Ringle et al., 2012) and the higher-order construct as the latent variables scores of the first-order constructs were presented in Figure 5.10.

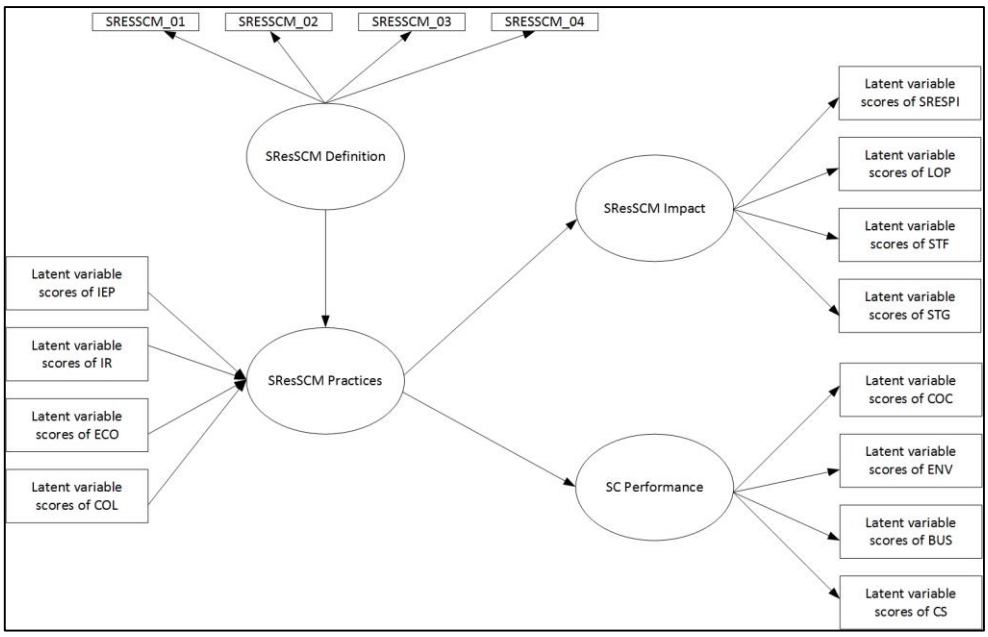

Figure 5.10: The second stage of the measurement model evaluation after EFA process

According to Becker et al. (2012) the explain that "the exogenous construct has an effect on the second-order construct and the second-order construct influences that final endogenous construct" (p.367). This approach produces generally less biased, and therefore, more precise parameter estimates and a more reliable higher-order construct score. Therefore, based on Figure 5.10, the definition of SResSCM influences SResSCM practices, which then influences SResSCM impact and supply chain performance. Consequently, the next section will present the evaluation of measurement model and structural model for this thesis.

5.3.6. Evaluation of the measurement model

The objective of this section was to explain the procedure, by which the measurement model validation requirements of the Partial Least Squares (PLS) statistic approach satisfied each of the items used in this study. After the EFA process, all remaining variables were put into smartPLS 3.0 programme, following Hair et al. (2016) procedures. The evaluation of PLS models typically follows a two-level process (Hair et al., 2016). The first level includes the assessment of measurement models where different approaches for reflective measurement (Mode A) and formative measurement (Mode B) models are employed. The measurement model specifies the relationship between observation variables, which build the items of the questionnaire and the latent constructs. The independent variable, as SResSCM practices, was specified formatively because the aim of this study was to identify the relevance of each practice measure. By the way, the remaining variables were reflective measurement model. Hair et al. (2016) state " if you have reflective measurement models, you interpret the outer loadings results. In contrast, if you have formative measurement models, then you primarily interpret the outer weights results" (p.96). Hence, in this thesis, the researcher interprets outer loading for reflective measurement model for SResSCM Definition construct, SResSCM impact construct and SC performance construct and then interprets outer weights for formative measurement model for SResSCM practices construct. The second level is explained in the next section, as the evaluation of the structural model, which specifies the relationships between unobserved or latent variables.

Therefore, it can be summarized that in the first stage, the reliability and validity of the measurement model is evaluated and established. In the second stage the hypothesized relationships are tested via path modelling.

5.3.6.1 Reflective measurement model

The quality criteria used to confirm the quality of the measurement model were in accordance with Hair et al. (2016), assessing internal consistency reliability (also known as composite reliability), convergent validity and discriminant validity, as

shown in Table 5.21. Reliability was evaluated by the composite reliability and the indicator reliability, which were measured by taking the outer loading into account. For all constructs, the required threshold of Cronbach's alpha and composite reliability values were above 0.70 (Hair et al., 2010; Hair et al., 2011; Hair et al., 2016). The composite reliabilities were all well above the recommended threshold, ranging from 0.856 – 0.981 (Nunnally, 1978). Moreover, Cronbach's alpha was also well above the average threshold of 0.879, ranging between 0.671 – 0.979. The lowest Cronbach's alpha was COL at 0.671, but the researcher regarded this indicator of the construct as acceptable value.

To evaluate convergent validity, the outer loading of the indicators, preferably above 0.70, and as well as the average variance extracted (AVE), for which the suggested threshold was above 0.50 (Fornell and Larcker, 1981), were conducted (Hair et al., 2016). The analysis of convergent validity is shown under factor loading in Table 5.21, which shows how well each indicator was correlated with the construct that it was connected to. All reflective indicators had a loading of more than 0.7. The assessment focused only on the outer loadings of the reflective constructs, i.e. IEP, IR, BUS, COC, CS, and so on. Furthermore, average AVE for all reflective indicators showed value higher than the threshold (>0.5) about 0.712, ranging from 0.457 – 0.838. However, there were two AVE values which did not reach the threshold, being SResSCM impact (0.457) and supply chain performance (0.485), as these values were higher-order components (HOC), which captured the more abstract higher-order entity (Hair et al., 2016). Therefore, as the value of composite reliability and Cronbach's alpha for these two values was well above the critical threshold, the researcher retained all repeated indicators of the construct.

Finally, examining the degree of divergence of each construct is known as discriminant validity analysis (Hair et al., 2016). Discriminant validity was evaluated by two approaches, i.e. the cross loading of the indicators and the Fornell-Larcker criterion. For this study, the square root of the AVE scores for each construct was compared with their correlation with the other constructs (Fornell and Larcker, 1981). It is recommended that the square root of AVE scores should be greater than

their correlation with the other constructs (Chin, 1998). Table 5.22 reveals the correlation matrix of constructs and the square root of AVE scores in bold. According to the obtained result, off-diagonal results (correlation of constructs) were less than the bolded diagonal (square root of AVE scores) values. Moreover, the cross-loading, as demonstrated in Appendix K, provided initial support for the reflective constructs' discriminant validity, as each reflective indicator loaded highest on the construct it was linked to (Hair et al., 2016). Furthermore, Hair et al. (2016) suggested considering the Heterotrait-Monotrait Ratio (HTMT) statistics to overcome several shortcomings of traditional approaches for discriminant validity assessment. HTMT uses 0.85 as the relevant threshold level. Appendix L shows HTMT values were clearly lower than the more conservative threshold value (at 0.85). Thus, there was no problem with discriminant validity, which indicated the validity of the proposed measurement model (Hair et al., 2016). It was therefore concluded that the measurement model was reliable.

Table 5.21: Assessment of reflective measurement models

Construct	Indicators	Mean	SD	Loading	CR	α	AVE
Sustainable and resilient supply chain management (SResSCM)	SRESSCM_01	4.160	0.727	0.955	0.922	0.892	0.749
	SRESSCM_02	4.120	0.765	0.809			
	SRESSCM_03	4.110	0.760	0.876			
	SRESSCM_04	4.040	0.870	0.707			
Sustainable and resilient supply chain management practices	The repeated indicator approach with mode B (reflective-formative hierarchical latent variables)						
Internal and external plan (IEP)	IEP _01	4.610	0.784	0.819	0.952	0.943	0.713
	IEP _02	4.420	0.933	0.903			
	IEP _03	4.500	0.955	0.884			
	IEP _04	4.330	1.047	0.852			
	IEP _05	4.460	0.900	0.822			
	IEP _06	4.260	1.081	0.873			
	IEP _07	4.620	0.750	0.795			
	IEP _08	4.100	1.239	0.811			
Investment Recovery (IR)	IR_01	4.020	1.379	0.927	0.904	0.841	0.759
	IR_02	3.680	1.676	0.794			
	IR_03	4.460	1.106	0.889			
ECO-design (ECO)	ECO_01	2.980	1.503	0.744	0.876	0.793	0.708
	ECO_02	3.790	1.187	0.876			
	ECO_03	3.600	1.340	0.889			
Collaboration (COL)	COL_01	3.150	1.622	0.805	0.856	0.671	0.749
	COL_02	3.880	1.332	0.918			
Supply chain performance	2nd order construct, repeated items measuring, COC, ENV, BUS, and CS were employed				0.933	0.923	**0.485**
Customer and operational cost (COC)	COC_01	4.300	0.565	0.829	0.904	0.872	0.611
	COC_02	4.290	0.636	0.753			
	COC_03	4.210	0.725	0.741			
	COC_04	4.250	0.726	0.829			
	COC_05	4.150	0.782	0.771			
	COC_06	4.120	0.670	0.761			
Environmental cost (ENV)	ENV_01	3.960	0.749	0.918	0.922	0.886	0.749
	ENV_02	3.980	0.779	0.943			
	ENV_03	3.890	0.838	0.803			
	ENV_04	4.060	0.698	0.787			
Business Wastage (BUS)	BUS_01	4.170	0.718	0.874	0.895	0.824	0.741
	BUS_02	4.210	0.700	0.802			
	BUS_03	4.150	0.770	0.903			
Customer Satisfaction (CS)	CS_01	3.850	0.847	0.930	0.912	0.808	0.838
	CS_02	3.830	0.915	0.900			

Table 5.21: Assessment of reflective measurement models (CONT)

Sustainable and resilient supply chain management impact	2nd order construct, repeated items measuring, SRESPI, LOP, STF, and STG were employed				0.964	0.961	**0.457**
SResSCM practices impact (SRESPI)	SRESPI_01	3.020	1.282	0.925	0.981	0.979	0.765
	SRESPI_02	2.900	1.246	0.914			
	SRESPI_03	2.910	1.162	0.884			
	SRESPI_04	3.020	1.261	0.899			
	SRESPI_05	3.030	1.306	0.915			
	SRESPI_06	2.980	1.157	0.904			
	SRESPI_07	3.060	1.227	0.906			
	SRESPI_08	3.030	1.292	0.897			
	SRESPI_09	2.810	1.192	0.888			
	SRESPI_10	2.990	1.191	0.860			
	SRESPI_11	2.860	1.238	0.875			
	SRESPI_12	2.810	1.148	0.903			
	SRESPI_13	2.860	1.093	0.841			
	SRESPI_14	2.850	1.096	0.792			
	SRESPI_15	2.800	1.240	0.813			
	SRESPI_16	2.710	1.024	0.761			
Long-term Organization performance (LOP)	LOP_01	3.230	0.817	0.885	0.963	0.955	0.764
	LOP_02	3.300	0.804	0.876			
	LOP_03	3.300	0.827	0.927			
	LOP_04	3.270	0.762	0.898			
	LOP_05	3.270	0.820	0.877			
	LOP_06	3.290	0.755	0.855			
	LOP_07	3.330	0.813	0.924			
	LOP_08	3.410	0.767	0.735			
Short-term Financial (STF)	STF_01	2.950	0.718	0.910	0.943	0.919	0.804
	STF_02	2.960	0.713	0.882			
	STF_03	3.000	0.763	0.928			
	STF_04	2.950	0.693	0.866			
Short-term Growth (STG)	STG_01	3.050	0.802	0.954	0.939	0.912	0.795
	STG_02	3.030	0.792	0.907			
	STG_03	3.040	0.738	0.907			
	STG_04	3.140	0.784	0.790			

Table 5.22: Test of discriminant validity (Fornell-Larcker Criterion)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
BUS (1)	**0.861**											
COC (2)	0.639	**0.781**										
COL (3)	0.198	0.225	**0.865**									
CS (4)	0.543	0.467	0.154	**0.915**								
ECO (5)	0.310	0.448	0.320	0.291	**0.841**							
ENV (6)	0.619	0.595	0.291	0.475	0.314	**0.866**						
IR (7)	0.314	0.381	0.485	0.141	0.395	0.315	**0.871**					
LOP (8)	0.170	0.127	0.168	0.198	0.289	0.276	0.144	**0.874**				
IEP (9)	0.481	0.488	0.539	0.201	0.516	0.357	0.727	0.115	**0.844**			
SRESPI (10)	0.200	0.113	-0.048	0.086	0.230	0.098	0.019	0.376	0.062	**0.875**		
STF (11)	0.164	0.334	0.272	0.417	0.249	0.319	0.121	0.467	0.101	0.173	**0.897**	
STG (12)	0.347	0.270	-0.001	0.355	0.437	0.269	0.051	0.488	0.159	0.377	0.662	**0.892**

5.3.6.2 Formative measurement model

There are various approaches to deal with the assessment of the formative measurement model, so the researcher examined the PLS-SEM results of formative measurement models following the procedure outlined by (Hair et al., 2016). Becker et al. (2012) recommended that "the repeated indicator approach with mode B (formative measurement model) on the higher-order construct and inner path weighting scheme should be used for reflective-formative hierarchical latent variables. Because this approach provides generally less biased, and therefore, more precise parameter estimates and more reliable higher-order construct score" (p.376). Consequently, this study applied the formative higher-order construct in SResSCM practices with four constructs, i.e. IEP, IR, ECO and COL. There are three steps for formative measurement models assessment procedure (Hair et al., 2016): (1) assess convergent validity of formative measurement models; (2) assess formative measurement models for collinearity issues; and (3) assess the significance and relevance of the formative indicators. Table 5.23 and 5.24 demonstrate the assessment of formative measurement models from smartPLS programme with outer weights, collinearity statistics (VIF), *t*-statistic and *p* value.

To assess convergent validity of the formative measurement model, the researcher would need to create new model for redundancy analysis. However, this study did not contain single-item measures with generic assessments of these phenomena. So, this study could not evaluate convergent validity for formative validity.

In the next step, the researcher needed to check for collinearity of indicators by checking the formative indicators' Variance Inflation Factor (VIF) values, because multicollinearity is another important criterion (Hair et al., 2016). High multicollinearity could mean that the indicator's information is redundant. Hair et al. (2016) (p.143) explained "More specifically, an indicator's VIF level of 5 indicates that 80% of its variance is accounted for by the remaining formative indicators associated with the same construct". As same as Hair et al. (2014) illustrate "the weights linking the formative indicators with the constructs (which represent each indicators' contribution to the construct, controlling for the influence of all other

indicators of the same construct" could be reversed and their significance underestimated as a result of increased standard errors" (p.112). Therefore, the researcher needed to follow collinearity assessment in formative measurement models using the VIF suggested by Hair et al. (2016) (p.145). Table 5.24 shows that the highest VIF value was IEP_02 (5.674), which was more than the threshold at value 5; moreover, the average VIF from all indicators was 2.704. Then, the researcher treated collinearity issues with the SPSS programme, and the results for collinearity statistics showed all VIF values at less than 5 (see Table 5.24). When all VIFs are lower than the boundary value of 5, high multicollinearity poses no problem (Hair et al., 2016).

The last step was the assessment of outer weight with bootstrapping procedure to examine the significance and relevance of the indicators. Rai et al. (2006) state "as the interpretation of the weights is similar to the beta coefficients in a standard regression model, it is usual to have lower absolute weights as compared to loadings. The PLS method does not directly provide significance tests and confidence interval estimates the significance of path coefficients, a bootstrapping technique was used" (p.235). The outer weight is the result of a multiple regression, with the latent variable scores as the dependent variable, and the formative indicators as the independent variable (Hair et al., 2016). Moreover, Hair et al. (2016) mentioned that researchers must test if the outer weights in formative measurement models are significantly different from zero, by means of the bootstrapping procedure, for which 5,000 bootstrap samples are recommended. Consequently, this study applied 5,000 bootstrap samples and 113 bootstrap cases, using no sign changes option in smartPLS 3.0 programme. However, there is no minimum threshold values for indicator weights have been established (Rai et al., 2006) but the statistical significance of weights can be used to determine the relative importance of indicators in forming a latent construct. As same as Henseler et al. (2016) explained "the indicator weights are determined such that each proxy shares as much variance as possible with the proxies of causally related constructs" (p.5). The results of weights and their significance are differentiated; it suggests that the outer weights of ECO indicator were statistically significant.

According to *t*-statistic and *p* value, ECO formative indicators are significant at a 1% level (t-statistic > 2.57) (Hair et al., 2016). However, other formative indicators were not statistically significant, but their outer loading was well over the acceptable level of 0.5 for IR and IEP indicators. Hair et al. (2016) explain if the outer weights for indicator is non significant but outer loading more than 0.50, the indicator can be interpreted as not relatively important. Furthermore, even though the outer weight and outer loading of COL was not significant, the *t* value for path coefficients was 7.015, indicating a significance at *p* <0.001. Therefore, the researcher retained all formative constructs for this model.

Table 5.23: Quality criteria for formative measurement model

Formative Constructs	Formative Indicators	Outer weight (Outer loading)	*t-statistic*	*p* value	VIF
SResSCM Practices	COL	-0.011 (0.409)	7.015*	0.000	1.450
	ECO	0.819 (0.968)*	5.603*	0.000	1.369
	IR	-0.023 (0.523)	12.206*	0.000	2.180
	IEP	0.313 (0.714)	16.973*	0.000	2.644

* The indicator is significant at the level of 0.01 (2-tailed)

Table 5.24: Assessment of 2nd-order reflective-formative measurement models

Formative Constructs	First-order constructs	Indicators	First-order constructs (Reflective)				High-order dimensions (Formative)				SPSS	
			Outer weight (Outer loading)	*t-statistic*	*p* value	VIF	Outer weight (Outer loading)	*t-statistic*	*p* value	VIF	Tolerance	VIF
SResSCM Practices	Internal and external plan (IEP)	IEP _01	0.104 (0.800)	8.455	0.000	3.109	-0.117 (0.455)	1.109	0.268	3.487	0.331	3.022
		IEP _02	0.158 (0.905)	29.780	0.000	5.501	-0.040 (0.691)	0.284	0.776	5.674	0.261	3.827
		IEP _03	0.146 (0.877)	19.507	0.000	4.237	0.075 (0.640)	0.574	0.566	4.868	0.251	3.991
		IEP _04	0.169 (0.862)	24.219	0.000	3.668	0.149 (0.741)	1.093	0.274	3.878	0.277	3.605
		IEP_05	0.142 (0.819)	14.510	0.000	2.860	0.208 (0.622)	1.895	0.058	3.092	0.337	2.970
		IEP _06	0.170 (0.878)	21.932	0.000	3.409	0.240 (0.745)	1.855	0.064	3.748	0.288	3.471
		IEP _07	0.106 (0.776)	10.691	0.000	2.590	-0.079 (0.464)	0.573	0.567	3.021	0.477	2.098
		IEP _08	0.184 (0.830)	22.507	0.000	2.834	0.183 (0.808)	1.632	0.103	3.567	0.314	3.182
	Investment Recovery (IR)	IR_01	0.380 (0.924)	11.578	0.000	3.057	0.026 (0.516)	0.233	0.816	4.162	0.368	2.716
		IR_02	0.330 (0.794)	8.246	0.000	1.709	0.043 (0.449)	0.437	0.662	2.090	0.567	1.765
		IR_03	0.434 (0.891)	12.559	0.000	2.401	-0.063 (0.59)	0.373	0.709	4.365	0.473	2.113
	ECO-design (ECO)	ECO_01	0.349 (0.785)	11.195	0.000	1.503	0.254 (0.669)	1.862	0.063	1.863	0.649	1.540
		ECO_02	0.417 (0.859)	21.424	0.000	1.786	0.238 (0.798)	2.119	0.034	2.136	0.556	1.798
		ECO_03	0.419 (0.822)	27.745	0.000	1.919	0.225 (0.802)	1.782	0.075	2.341	0.556	1.800
	Collaboration (COL)	COL_01	0.488 (0.822)	4.496	0.000	1.343	0.000 (0.320)	0.004	0.996	1.427	0.740	1.352
		COL_02	0.660 (0.907)	5.431	0.000	1.343	-0.076 (0.433)	0.571	0.568	2.104	0.740	1.352

As Cenfetelli and Bassellier (2009) argued when the researchers interpret formative measurement model with outer weights, there are two value types as positive and negative indicator weights. According to Table 5.23, there are positive and negative

indicator weights for this study, such as COL and IR are negative indicators and ECO and IEP are positive indicators. The researcher can then interpreted this meaning, as “when ECO and IEP are otherwise equal, increased amount of COL and IR will reduce the degree of SResSCM practices”. However, even COL and IR weights are low but these indicators are still significant, thus this result suggests that even though the unique contributions of these indicators to SResSCM practices is small in comparison to ECO and IEP indicators, there is a still strong bivariate relationship between COL/IR indicators and SResSCM practices.

Moreover, the results showed ECO has higher outer weight values than other indicators; however, the researcher cannot summarize that ECO is the most correlate positively with SResSCM practices construct because the outer weights are calculated as the regression weights resulting from the ordinary least squares regression of each latent variable’s inner proxy on its indicators (in Mode B) (Henseler et al., 2012). Furthermore, as argued by Henseler et al. (2016) “a typical characteristic of SEM and factor-analytical tools in general is sign indeterminacy, in which the weight or loading estimates for a factor or composite can only be determined jointly for their value but not for their sign” (p.7). Therefore, the researcher can conclude that SResSCM practices construct can be measured with IEP, IR, ECO and COL indicators as there is no changed are required to the original algorithm, because the non-linear terms do not have any indicators assigned (Henseler et al., 2012).

The analysis of outer weights concludes the evaluation of the formative measurement models. Considering the results from reflective measurement model and formative measurement model jointly, all constructs exhibited satisfactory levels of quality, reliability and validity. Therefore, the study proceeds with the evaluation of the structural model by focusing on the hypothesized relationships between the constructs in the next section.

5.3.7. Evaluation of the structural model

When the evaluation of the measurement model was measured, it was followed by the evaluation of the structural model, which covered the relationships between hypothesis constructs (Henseler et al., 2009). With the satisfactory results in the measurement model, the study subsequently assessed the structural model to confirm the relationships among constructs by using PLS-SEM with smartPLS 3.0 programme. The PLS structural model was measured by examining the hypothesized relationship of the constructs, the coefficient of determination (R^2), the path coefficients and their statistical significance (Hair et al., 2016). To assess the statistical significance between latent variables (constructs), traditional parametric tests were inappropriate in PLS (Chin, 2003). Then, bootstrapping, as a non-parametric test, was applied to test the statistical significance of the model paths. This procedure entailed generating 5,000 sub-samples of cases that were randomly selected with replacements from the original data set, of which the bootstrap sample size was equal to the number of data points as 113 cases. Hair et al. (2016) (p.191) suggested a systematic approach to the evaluation of structural model results (as in Figure 5.11). This involves examining the model's predictive capabilities and the relationship between the constructs.

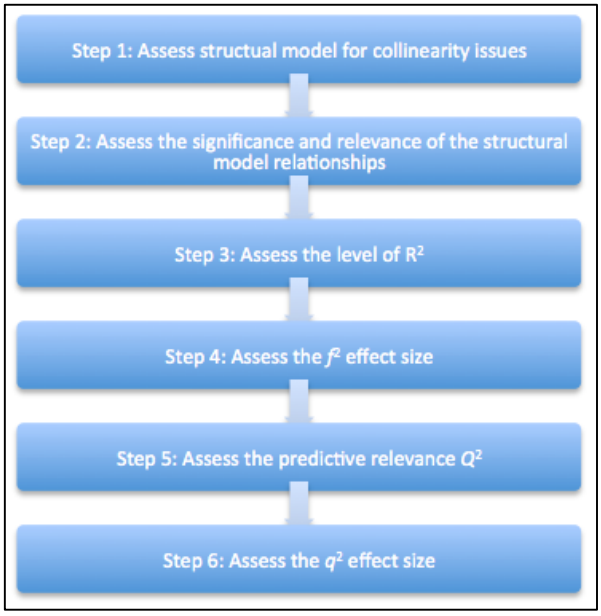

Figure 5.11: Structural model assessment procedure *(Source:* Hair et al. (2016), p.191*)*

The evaluation of the structural model was based on the findings from the standard model estimation, the bootstrapping routine and the blindfolding procedure (Hair et al., 2016). After the researcher had run the PLS-SEM algorithm using the same algorithm and missing values settings as in the measurement model stage, smartPLS 3.0 Programme showed the key results of the model estimation, as explained below.

Step 1: Collinearity assessment

First of all, it began with checking the structural model for collinearity issues by examining the VIF values of all sets of predictor constructs in the structural model (Hair et al., 2016). Table 5.25 shows the VIF values of all combinations of endogenous constructs. As you can see, all VIF are clearly below the threshold of 5 (Hair et al., 2016). Thus, collinearity among the predictor constructs was not a critical issue in the structural model (Hair et al., 2016).

Table 5.25: VIF Values in the structural model

Second set		Third set	
Construct	VIF	Constructs	VIF
SResSCM Practices	1.000	SC Performance	1.000
		SResSCM Impact	1.000

Step 2: Structural model path coefficients

The researcher used PLS-SEM algorithm by using smartPLS 3.0 programme with a path weighting scheme, initial outer weights of +1, maximum iterations of 300, and a stop criterion of 10^{-7}. The results from smartPLS 3.0 were obtained for the structural model relationships, which represented the hypothesized relationships among the constructs as presented in Figure 5.12 (Hair et al., 2016). Estimated path coefficients had standardized values between -1 and +1; however, the closer the estimated coefficients are to zero the weaker the relationships, which is usually not significantly different from zero (Hair et al., 2016).

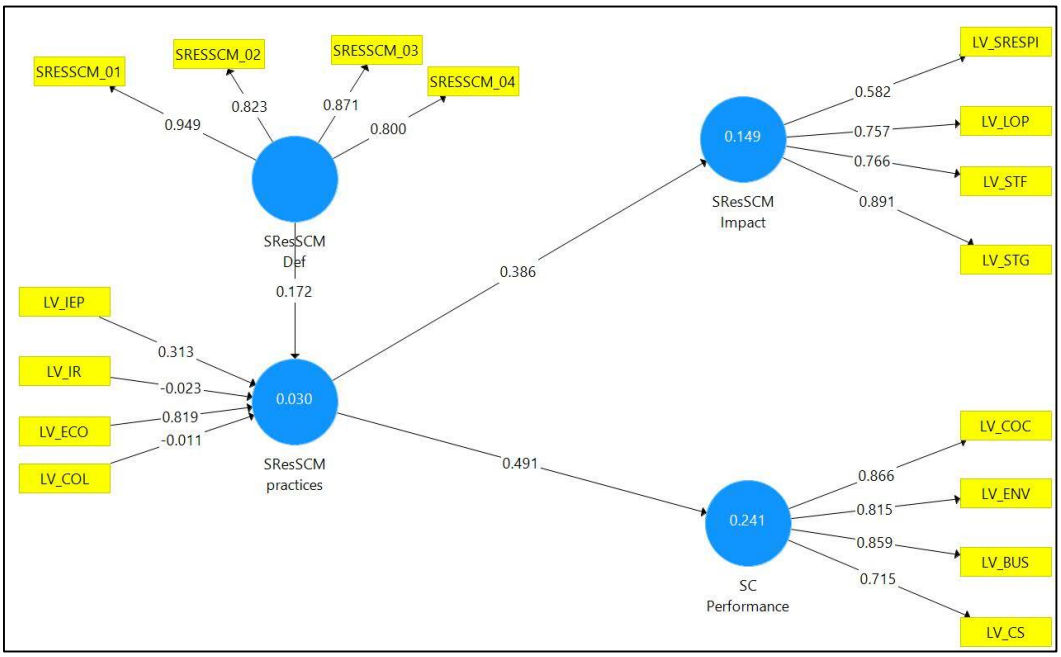

Figure 5.12: Path coefficients for structural model

For this study, the relative importance of the exogenous driver construct for the endogenous construct such as SC performance and SResSCM impact was SResSCM practices with the value 0.491 and 0.386, respectively. However, SResSCM definition has low coefficients with SResSCM practices, with the value = 0.172. Based on this result, it would appear that the relationship between (1) SResSCM practices and SC performance and (2) SResSCM practices and SResSCM impact are significance but it seems very unlikely that the hypothesized path relationship of SResSCM Def and SResSCM practices is not significance. As similar as Hair et al. (2016) illustrate "path coefficients with standardized values above 0.20 usually significant and those with values below 0.10 are usually not significant" (p.97).

Whether a coefficient is significant ultimately depends on its standard error that is obtained by means of bootstrapping (Hair et al., 2016). Therefore, the researcher used bootstrapping to assess the significance of path coefficients, which represent the hypothesized relationship among the constructs. The bootstrap standard error enabled computing the empirical *t* values and *p* values for all structural path coefficients (Hair et al., 2016). As mentioned by Hair et al. (2016) (p.195), "commonly used critical values for two-tailed tests are 1.65 (significant level =

10%), 1.96 (significant level = 5%), and 2.57 (significant level = 1%), thus when an empirical *t* value is larger than the critical value, the coefficient is statistically significant at a certain error probability".

Then, the researcher analysed the structural model relationships by using bootstrapping procedure, advised by Hair et al. (2016). Table 5.26 shows the bootstrapping results. Assuming a 1% significance level, it can be seen that two relationships on the structural model were significant as SResSCM practices → SResSCM impact (*t* statistic = 2.947, *p* value = 0.005), and SResSCM practices → SC performance (*t* statistic = 4.162, *p* value = 0.000), except SResSCMDef → SResSCM practices (*t* statistic = 0.644, *p* value = 0.520) were not significant at any significant level. These results suggest that the organizations did not concentrate on SResSCM definitions, but had already applied SResSCM practices. Besides, the organizations were aware about the impact of SResSCM when they applied SResSCM practices, and were thus concentrating on enhancing their organizational performance and practices in the short and long-term.

Table 5.26: Significance testing results of the structural model path coefficients

	Path Coefficients	*t* Values	*p* Values	Significance?
SResSCM Def -> SResSCM practices	0.172	0.644	0.520	No
SResSCM practices -> SC Performance	0.491	4.162	0.000	Yes
SResSCM practices -> SResSCM Impact	0.386	2.947	0.005	Yes

Table 5.27: Bootstrapping results for outer model

	Outer Loading	*t* Values	*p* Values	Significance?
SResSCM Def --> SRESSCM_01	0.949	1.231	0.222	No
SResSCM Def --> SRESSCM_02	0.823	1.197	0.232	No
SResSCM Def --> SRESSCM_03	0.871	1.193	0.234	No
SResSCM Def --> SRESSCM_04	0.800	1.189	0.239	No
SC Performance --> Latent variables of BUS	0.859	7.232	0.000	Yes
SC Performance --> Latent variables of COC	0.866	7.009	0.000	Yes
SC Performance --> Latent variables of CS	0.715	5.076	0.000	Yes
SC Performance --> Latent variables of ENV	0.815	7.533	0.000	Yes
SResSCM Impact --> Latent variables of SRESPI	0.582	2.612	0.014	Yes
SResSCM Impact --> Latent variables of LOP	0.757	3.548	0.001	Yes
SResSCM Impact --> Latent variables of STF	0.766	3.551	0.001	Yes
SResSCM Impact --> Latent variables of STG	0.891	3.903	0.000	Yes

As presented in Table 5.27, SC performance also had a significant level at 1% for all latent variables such as LV_BUS (*t* values = 7.232), LV_COC (*t* values = 7.009), LV_CS (*t* values = 5.076) and LV_ENV (*t* values = 7.533), which higher than significance level at 1% (*t* values should higher than 2.57), similar to the SResSCM impact, which had significance with their latent variables, such as LV_STG (*t* values = 3.903), LV_STF (*t* values = 3.551), LV_LOP (*t* values = 3.548) and LV_SRESPI (*t* values = 2.612), which all t values higher than 2.57 (for significance level = 1%). However, the *t* values of SResSCMDef show that they are not significant within this model, for examples, SRESSCM_01 (*t* values = 1.231), SRESSCM_02 (*t* values = 1.197), SRESSCM_03 (*t* values = 1.193) and SRESSCM_04 (*t* values = 1.189), which lower than 1.65 (for significance level of 10%).

Step 3: Coefficients of determination (R^2 value)

The calculations for R^2 values, of the combination between the exogenous latent variable's combined effects on the endogenous latent variables (Hair et al., 2016), are presented (see Table 5.28). This coefficient is a measurement of the model's predictive power and is calculated as the squared correlation between a specific endogenous latent variable. Following Hair et al. (2016) rules of thumb, the R^2 values of SResSCM impact (0.149) and SC performance (0.241), can be considered moderate value, whereas, the R^2 value for SResSCM practices (0.030) is rather weak.

Table 5.28: R^2 and Q^2 values of the endogenous latent variables

Constructs	R^2 Value	Q^2 Value
SC Performance	0.241	0.139
SResSCM Impact	0.149	0.059
SResSCM Practices	0.030	NA

Step 4: Effect size f^2

Next, to evaluate the effect sizes f^2 for all structural model relationships, Table 5.29 shows f^2 values for all combinations of endogenous constructs and corresponding exogenous constructs. The effect size is used to evaluate the changing R^2 values when a specified exogenous construct is deleted from the model in order to

measure the omitted construct (Hair et al., 2016). Cohen (1988) provided guidelines for evaluating f^2 as values of 0.02, 0.15, and 0.35, respectively, representing small, medium, or large effects of the exogenous latent variables. Moreover, f^2 values of less than 0.02 suggest that there is no effect. For this study, it can be seen that SResSCM Definition had a small effect size of 0.031 on SResSCM practices. However, SResSCM practices had a medium effect size of 0.318 on SC performance, and 0.175 on SResSCM impact. These results have the same interpretation as path coefficients and coefficients of determination from previous steps.

Table 5.29: f^2 values and q^2 values of all paths in the model

Paths	f^2 Effect size	q^2 Effect size
SResSCM Def --> SResSCM Practices	0.031	NA
SResSCM Practices --> SC Performance	0.318	0.173
SResSCM Practices --> SResSCM impact	0.175	0.043

Step 5: Blindfolding and predictive relevance Q^2

Hair et al. (2016) suggested researchers should examine Stone-Geisser's Q^2 value (Geisser, 1974; Stone, 1974), as a criterion of predictive accuracy. In structural model, Q^2 values larger than zero mean the exogenous constructs have predictive relevance for the endogenous construct under consideration, while Q^2 values of 0 and below mean a lack of predictive relevance (Hair et al., 2016). Q^2 values are usually applied to endogenous constructs that have a reflective measurement model, so this procedure did not apply to the formative measurement model for this study. To calculate Q^2 value, the blindfolding procedure was applied in PLS-SEM (smartPLS 3.0) with an omission distance (D) of 7. Hair et al. (2016) referred to the criterion that when the sample size was divided by D it must not yield an integer. This study had 113 observations, so it could choose an omission distance of D = 7. As demonstrated in Table 5.28, all Q^2 values were considerably above zero (for SResSCM impact and SC performance), suggesting the model's predictive relevance regarding the endogenous latent variables.

Step 6: Effect size q^2

The last step is to compare means of the measure to the q^2 effect size (Hair et al., 2016). This step is similar to the f^2 effect size by assessing an exogenous construct's contribution to an endogenous latent variable's Q^2 value. Hair et al. (2016) suggested threshold level for q^2 values of 0.02, 0.15 and 0.35 means that an exogenous construct has a small, medium, or large predictive relevance for a certain endogenous construct. Table 5.29 shows the effect size q^2 by manual calculation; the effect size q^2 for the relationship between SResSCM Practices with SC performance and SResSCM impact can be considered medium effect size for this relation.

Moreover, this study also presents the total effects between supply chain performance construct and its latent variables as Table 5.30. With regards to SC performance, it can be seen that among the four endogenous drivers constructs, COC was the most strongly affected by SC performance (0.881), followed by BUS (0.841), ENV (0.840) and CS (0.673). Moreover, the total effect of SResSCM practices on these SC performance latent variables showed that COC was the most affected by SResSCM practices (0.512), followed by BUS (0.489), ENV (0.488), and CS (0.391). Furthermore, SResSCM practices had a strong effect on SC performance (0.491 and 0.571). Therefore, it can be concluded that the organizational aspects most affected by the implementation of SResSCM practices in organizations were: COC first, followed by BUS, ENV, and CS, respectively.

Table 5.30: Total effects of SC performance construct

Total effects of SC performance and all constructs	
SC Performance -> Business Wastage (BUS)	0.841
SC Performance -> Customer and Operational Cost (COC)	0.881
SC Performance -> Customer Satisfaction (CS)	0.673
SC Performance -> Environmental Cost (ENV)	0.840
SResSCM Practices -> Business Wastage (BUS)	0.489
SResSCM Practices -> Customer and Operational Cost (COC)	0.512
SResSCM Practices -> Customer Satisfaction (CS)	0.391
SResSCM Practices -> Environmental Cost (ENV)	0.488
SResSCM practices -> SC Performance	0.491

Lastly, PLS-SEM results showed the total effects between SResSCM impact construct and its latent variables in Table 5.31. With regard to SResSCM impact, it can be seen that among the four endogenous drivers constructs, SRESPI was most strongly affected by SResSCM impact (0.841), followed by LOP (0.746), STG (0.702) and STF (0.561). Moreover, the total effects of SResSCM practices on these SResSCM impact latent variables showed that SResSCM practices had the greatest total effect on SRESPI (0.295), followed by LOP (0.262), STG (0.246) and STF (0.197). Therefore, it can be concluded that organizations implementing SResSCM will first notice an impact on their organizational practices, followed by organizational performance, i.e. LOP, STG and STF, respectively.

Table 5.31: Total effects of SResSCM impact

Total effects of SResSCM impact on all constructs	
SResSCM Impact -> Long-term organization performance (LOP)	0.746
SResSCM Impact -> SResSCM Practices Impact (SRESPI)	0.841
SResSCM Impact -> Short-term Financial (STF)	0.561
SResSCM Impact -> Short-term Growth (STG)	0.702
SResSCM Practices -> Long-term organization performance (LOP)	0.262
SResSCM Practices -> SResSCM Practices Impact (SRESPI)	0.295
SResSCM Practices -> Short-term Financial (STF)	0.197
SResSCM Practices -> Short-term Growth (STG)	0.246
SResSCM practices -> SResSCM Impact	0.386

5.4 Hypotheses testing for this study

As mentioned in Section 2.10, this study used six hypotheses for testing related to the research objectives and research questions. It showed that some hypotheses were neither supported nor rejected. Thus, this section will summarize the results from these hypotheses. Further, Table 5.32 summarizes the hypotheses testing for this study.

Table 5.32: The conclusion of hypotheses testing results

Hypotheses	Supported or Not Supported
H_1: Sustainable supply chain management has a positive relationship on supply chain resilience management	**Supported**
H_2: Sustainable supply chain management definition has a positive effect on sustainable and resilient supply chain management practices	Not Supported
H_3: Supply chain resilience management definition has a positive effect on sustainable and resilient supply chain management practices	Not Supported
H_4: Sustainable and resilient supply chain management practices positively affect supply chain performance	**Supported**
H_5: Sustainable and resilient supply chain management practices have a positive impact on short-term organizational performance	**Supported**
H_6: Sustainable and resilient supply chain management practices have a positive impact on long-term organizational performance	**Supported**

5.4.1. H_1 testing results

Considering H_1: "Sustainable supply chain management has a positive relationship on supply chain resilience management", it can be seen from Phase One that all participants believed that SSCM and SRES were related; however they did not know what the exact relationship was for these two concepts. It might that SSCM supports SRES, or that SRES supports SSCM. Then, Phase Two confirmed that SSCM and SRES had a positive relationship. As Table 5.9 presented the EFA process for SResSCM definition, the results showed that two variables for SSCM definition and two variables for SRES definition had the same relation and were grouped by the same factor.

Thus, this study *supports* H_1 that SSCM has a positive relationship with SRES.

5.4.2. H_2 testing results

Regarding H_2: "Sustainable supply chain management definition has a positive effect on sustainable and resilient supply chain management practices", all three phases of collecting data found that the organizations had SSCM practices in their policy and procedure, but they did not fully understand the definition. For instance, it can be found that the practitioners applied practices relying on the organization's policy, but they did not know how important it was for the organization, or the

meaning of the applied process. Thus, the practitioners worked with their policy without an understanding of SSCM from the literature. Moreover, the survey results also showed that the relationship between SResSCM definitions (in terms of SSCM definition as SRESSCM_01 and SRESSCM_04) was not significant on SResSCM practice (Table 5.27).

Thus, this study *does not support* H_2 that the definition of sustainable supply chain management has a positive effect on sustainable and resilient supply chain management practices.

5.4.3. H_3 testing results

According to H_3: "Supply chain resilience management definition has a positive effect on sustainable and resilient supply chain management practices". This hypothesis is related to H_2. For example, the researcher found in the results from Phase One that the organizations did not understand the meaning of "Resilience", and the importance of resilience in a Thai context. However, some organizations had already been applying SRES practices in their policies. This might have been due to their experience from the previous disruptions. In addition, as with the results from H_3 in the survey, it can be seen that the definition of SRES was not significant to SResSCM practices.

Thus, this study *does not support* H_3 that SRES definition has a positive effect on SResSCM practices.

Furthermore, based on reconceptualised main study as presented in Section 5.3.5, the revised conceptual model combined H_2 and H_3 together and then the result from structural model as presented in Section 5.3.7 showed the relationship of hypothesized between SResSCM Def and SResSCM practices is not significance at any significant level. Thus, the researcher confirmed that the SSCM and SRES definitions (or SResSCM definition in this thesis) are not related to SResSCM practices in organizations.

5.4.4. H_4 testing results

H_4 studied SResSCM practices and SC performance. This study applied SC performance from the existing literature and found 15 SC performance variables from the survey results. SC performance construct had four first-order constructs, being COC, BUS, ENV and CS. Moreover, path coefficients with bootstrapping procedure from SResSCM practices to SC performance presented statistical significance at 1% significance level (*t*-values = 4.162) (Table 5.26). Hence it can be concluded that SResSCM practices have a positive relationship with SC performance.

Thus, this study *supports* H_4 that sustainable and resilient supply chain management practices positively affects supply chain performance.

5.4.5. H_5 testing results

H_5 was used to examine the relationship between SResSCM practices and their impact on short-term organizational performance. However, after conducted EFA process, short-term impact construct was combined with long-term impact construct namely, SResSCM impact, as presented before. The results showed that SResSCM practices had a 1% significant level on SResSCM impact (*t*-value = 2.947 and p-value = 0.005, Table 5.26). Furthermore, based on Table 5.27, the short-term variable constructs, i.e. short-term financial and short-term growth, also show support the proposed causal relationships, which had a significant level at 1% for these latent variables.

Thus, this study *supports* H_5 that sustainable and resilient supply chain management practices have a positive impact on short-term organizational performance.

5.4.6. H_6 testing results

For the last hypothesis of this study, it can be seen that when long-term organizational performance was combined with short-term organizational performance, it had a positive relationship with SResSCM practices. However, when

compared outer loading between short-term impact and long-term impact in Table 5.27. It can be found that long-term variable has less value than short-term variables. Thus, this study found that SResSCM practices had an immediate (short-term) impact, and had a long-term impact when combined with the short-term in EFA process. The reason might be the organizations understood the short-term impact better than long-term impact.

Thus, this study *supports* H_6 that SResSCM practices have a positive impact on long-term organizational performance.

The researcher concludes from the findings for each hypothesis there are three main outcomes: 1) There is a relationship between SSCM and SRES from the practitioners' perspectives, however there is no relationship between SSCM and SRES definition from academic on implemented practices in organization; 2) SResSCM practices help and support organizations to improve performance and supply chains once they successfully implement SResSCM practices; and 3) SResSCM practices also positively impact organizational performance in both the short and long-term impact through four main areas. These areas are sustainable and resilient supply chain management practices, long-term organization performance, short-term financial performance and short-term growth. Further discussions of hypothesis testing are presented in Chapter 7.

5.5 Summary of chapter

This chapter has presented, as Phase Two of the thesis, the survey process for this study. It included the sample and data collection process, and data analysis process, such as data examination, assessment of biases, descriptive analysis and measures of constructs. In this chapter, comprehensive, valid and reliable instruments for evaluating SResSCM definition, SResSCM practices, SResSCM impact, and SC performance were developed. PLS-SEM procedures have been employed in order to analyse the data from this survey. Descriptive analysis showed the information from this survey under different topics, such as the number of respondents, the

meaning and standard deviation for each question, respondents and their information, and so on. EFA process was used to study the relationship between each factor in each dimension. Then, remaining factors were analysed with smartPLS 3.0 programme. Regarding the measurement model, the instrument was tested, both for reflective and formative measurement model, using rigorous statistical tests, including reliability, convergent validity and discriminant validity. The results show high loading factors for remaining variables during measurement of model assessment. Moreover, the structural model found that there was a significant relationship between SResSCM practices and SC performance and organizational performance. However, it also found no significant relationship between SResSCM definition and SResSCM practices. Finally, the hypothesis testing concluded with the survey results. Some hypotheses were accepted, and some were rejected. The next chapter concerns Phase Three of this study, which discusses the structured interview, together with the survey results and practitioners, in order to gain more understanding for the study.

Chapter 6 PHASE THREE: STRUCTURED INTERVIEWS ANALYSIS AND RESULTS

6.1 Introduction

This chapter indicates the final stage of research methodology for this study, a structured interview (Phase Three), which was conducted in December 2016 in Thailand. The main purposes of Phase Three were to summarize the practitioners' perspectives and validate the overall results from previous phases to improve the reliability of this study. The results from the semi-structured interviews (Phase One) and survey (Phase Two) were concluded and discussed with a different group of supply chain and logistics practitioners or related positions in Thai manufacturing. However, there were some practitioners from Phase One in this Phase, i.e. Company A, B, C, D and F. While SResSCM is a new concept in Thailand, the results from this stage show that most of the companies had already been applying SResSCM practices. Thus, the findings from Phase One to Phase Three will improve the understanding and concept of SResSCM from both the practitioner's perspective and the academic's perspective.

This chapter is structured as follows: firstly, an overview of the analysis process is discussed; then the structured interview results are reviewed in the context of the four research questions. Finally, the chapter concludes with a summary, which will act as a prelude to Chapter 7.

6.2 Structured interview analysis

The structured interview section encompasses three sections, i.e. Sections A, B and C, as interview protocol (See Appendix C). Each interview took one and a half to two hours. The feedback from the practitioners helped to improve the overall validity and credibility of the interview findings. The results of Phase Three will be presented in the next section. According to Section B in the interview protocol, details of each question are stated in Table 6.1. The following section will present the results from this phase.

Table 6.1: Structure of the structured interview protocol

Section B Question	RQ	Explanation
Q1	RQ 1	The question asked about the relationships between SSCM and SRES from practitioner's perspective.
Q2	RQ 1	The question asked about the importance of an understanding of SSCM/SRES/SResSCM from practitioner's perspective.
Q3	RQ 2	The question asked about the new definition of SResSCM that was developed from previous stages.
Q4	RQ 2	Respondents need to explain how to implement SResSCM in the company.
Q5	RQ 1	Respondents need to discuss the results from the survey about the SResSCM definition and SResSCM practices.
Q6	RQ 1	Respondents need to indicate the organization's policy on SSCM and SRES.
Q7	RQ 3	The question lists about 16 SResSCM practice variables. Respondents need to rate the importance of each SResSCM practices from 1 to 10.
Q8	RQ 3	The question asked about the level of implementation of these practices in the company with 5 Point Likert's scale.
Q9	RQ 4	The question asked about SResSCM practices and SC performance and organizational performance.
Q10	RQ 4	Respondents need to rate SC performance factors from the survey with COC, ENV, BUS, and CS.
Q11	RQ 4	Respondents were asked to indicate SC performance on a scale of 1 to 10, on the importance of each SC performance and 5 Point Likert's Scale for SResSCM practices related to SC performance.
Q12	RQ 4	Respondents need to rate SResSCM's impact factors from the survey, i.e. SRESPI, LOP, STF, and STG.
Q13	RQ 4	Respondents were asked to answer what is the difference between short-term and long-term from the practitioner's perspective.
Q14		Respondents' feedback and suggestions to improve this study

6.2.1. Demographic analysis

Fourteen participants were contacted as the target group for the research study in Phase Three. There were five participants from Phase One and nine new participants who were interested in participating in the study. There were five electrical companies, five electronic companies, three automotive companies and one distributor. However, this phase involved just one person from each company, which is different from Phase One, where there were two or three persons from each company. The reason is that the participants from Phase Three were in a high

position in their company; thus the findings from each company were adequate for analysis. There were different sizes of companies in this phase, i.e. small (two companies), medium (two companies), and large (ten companies). Most of the companies were Thai companies (42.86%), American and Japanese companies (21.43%), and Korean and Joint Venture companies (Japanese-American) (7.14%). Various company positions took part in this interview, for instance, owner, co-chief executive, assistant manager administration, senior supply chain director and other managerial positions. Thus, this interview section will help to improve and validate the results from previous phases. The information from the companies is shown as follows:

Company A, B, C, D and F (interviewee 1, 2, 6, 7, and 9)

These companies attended Phase One of the study, the information of which is referred to in Section 4.2.1. However, Company E did not participate in this phase (due to time constraints of the participant).

Company G (Interviewee 10)

The company is located in Chonburi, and supplies materials for the automotive industry (i.e. tube) in Thailand as 1^{st} – 2^{nd} Tier suppliers. They execute cutting, forming, blending, plating and brazing processes for domestic companies and export to other customers outside Thailand. The mother plant is in Japan, and has more than 200 employees (being a large firm). Interviewee 10 has the experience in this company and automotive industry about 25 years. He has responsibility to take care their employees and also support their customers about the product quality. So he needs to apply SSCM and SRES concept into their company by testing and implementing suitable practices, such as cost reduction, workers' welfare or Kaizen's project that can improve the performance to their company. Therefore, interviewee 10 would provide important information to improve better concept for SResSCM for this thesis.

Company H (Interviewee 11)

This company is 100% Thai, being a small sized company (employees up to 50), located in Samutprakan. This company is a 1st - tier supplier that supplies materials for the electrical industry (air-conditioning companies). They produce air filters, PE tape and insulation. The company has annual revenue of between 50 million to 200 million Baht. Interviewee 11 works in electrical industry about thirty years and works in their company as factory manager about eleven years. So he applied his experience from the past, as he worked in Japanese company before, to use in this company. Some practices that interviewee 11 thought that it is importance, he applied in, such as ethical in working place or ethical with their customers, or the ideas as reduced, reused and recycled in some products. Moreover, Company H also provides raw materials to a big company in electrical industry so they need to support some requirements from their customers so Interviewee 11 needs to improve their company to support all of these requirements and have a good knowledge of SSCM and SRES in their company.

Company I (Interviewee 12)

This company is a 2nd – tier supplier who supplies materials to 1st - tier suppliers in Thailand's industrial sector. This is a large company with annual revenue of more than 200 million Baht. The main products are metal stamping and plastic injection. Their market encompasses automotive parts, electrical parts, construction tools, packaging, etc. Their main office and factory are located in Bangkok, Thailand. Although interviewee 12 works in this company about two years, but he has responsibility to control and plan the product quality. So interviewee 12 needs to deal with company's policy and their employee for improve better performance. Moreover, interviewee 12 has experiences to work with their employees with new company's policy, for example, interviewee 12 emphasizes to employees rather than other aspects because he believes that the company will achieve their goal when their employees understand company's goal. Thus, interviewee 12 would provide how to deal between company's policy and their employees.

Company J (Interviewee 13)

This company is a Korean company that moved their plant from South Korea to Chachoengsao, Thailand. They produce print-circuit-boards (PCB) and supply the electrical industry in Thailand. They are 1st and 2nd – tier suppliers with annual revenue of more than 200 million Baht and employ more than 200 workers. The mother plant is in South Korea, where all policies are formed. The company produces their products based on customer demand, and made to order only. Interviewee 13 works in this company about five years. His responsibility is to control a clean organization culture, to provide working welfare to their employees with environment, health and safety, and also compliance of the company's procedures with laws and ethical standards in Thailand and also in South Korea. SSCM concept was applied as business philosophy in this company; however, SRES concept was used within this company as well. For example, when it had a flooding in Chachoengsao Province, interviewee 12 needs to find and decide the best action to overcome that period. So after the disruption period, Company J has planned to move manufacturing to another plant in Thailand, where be safe than the current plant. Thus, interviewee 13 can provide insight material to improve SResSCM concept for this thesis.

Company K (Interviewee 14)

This company is 100% Thai, and produces raw materials for the automotive industry. They are 1st, 2nd, and 3rd – tier suppliers in this industry. The company is a large firm with annual revenue of more than 200 million Baht. The factory is located in Bangpoo Industrial Estate, Samutprakarn. There are four factories and one head office in Thailand. The products of the company are auto mirrors, lamps and plastic parts for OEM. 98% of products are supplied in Thailand and the other 2% exported overseas. Interviewee 14 works in this company more than 20 years so he will provide good important information related to SSCM and SRES from this company. Company K has implemented SSCM concept in some practices already, such as produce product that be environmentally friendly than before, provide working welfare to their employees, or sell scrap or unused materials from their production. Moreover, interviewee 14 needs to follow customer's requirement in some

products so he needs to discuss with his customers first and then discuss with his employees to control and produce the finished goods related to customer's requirement. Therefore, interviewee 14 also has some experiences in SSCM and SRES in his company.

Company L (Interviewee 15)

This company is a retailer manufacturing in the electrical industry in Thailand. The company is an original equipment manufacturer (OEM) with their own brand, and also provides products from contract manufacturers. Thus, they are a focal firm and 1st – tier customer of the supply chain in the electrical industry. The company has 51 to 200 workers, with annual revenue of more than 200 million Baht. There are four showrooms around Bangkok to show and sell their products. Interviewee 15 works in this company about two years but she has some experiences in electrical industry before. She has a responsibility to provide and support customer's requirement. She also needs to communicate with her customers to produce products related to sustainable concepts, such as environmentally friendly products, and communicate with her suppliers to provide environmentally friendly raw materials as well. Moreover, interviewee 15 also needs to reduce inventory stock in their warehouse so she needs to find the best alternative for this situation, such as create some events with more discount or create some campaigns to increase more sales volume for her company. Thus, interviewee 15 would provide some good examples for SSCM and SRES from her company.

Company M (Interviewee 16)

This company is 75% Japanese and 25% investors, being a Thailand-based manufacturer of high volume precision hard disk drive parts and precision electronic devices. The plant is located at Bangpa-in Industrial Estate in Ayutthaya Province. The company is a 1st – tier supplier with about 5,000 employees and annual revenue of more than 200 million Baht. Their products are 60% mobile devices, 30% for the automotive industry and 10% for the electrical industry. Interviewee 16 has an experience in this company about 13 years; he also is in business continuous management plan program in the company, which needs to

prepare and plan actions for unforeseen disruptions. Moreover, interviewee 13 has to deal with company's policy, such as reduced wastes, improve production performance and support customer's requirement for environmentally friendly. So interviewee 16 has some knowledge related to SResSCM in this thesis, which can provide some important information from his experience.

Company N (Interviewee 17)

The mother company is in the USA and this plant is one of their global plants. They are a focal firm with 2,000 employees in this plant. Their annual revenue is more than 200 million Baht. They are a global electronic manufacturing service (EMS) company, providing manufacturing and product design services to the automotive, medical, telecommunication, industrial control and aerospace industries. As interviewee 17 works in this company more than twenty years so he can provide the concept of logistics and supply chain management in this company clearly. He believes that company should produce and provide products related to customer's requirement so how to support the customers are the main purpose in his company. Thus, interviewee 17 has a good experience in SSCM and SRES from practitioner's perspective and he would provide better insight information for SResSCM that related to this thesis.

Company O (Interviewee 18)

This is a Thai small-sized company with just three workers. Due to technology changing over time, this company needs to resize from medium to small. The product of the company is air conditioning parts, supplying large industry and office buildings. Normally, they use sub-contractors for the production process, as they do not want to invest in machines and warehouses. Interviewee 18 is an owner of Company O; he works in this company more than twenty years. So he provides all concepts in his company by himself. Therefore, the experience from interviewee 18 will support this thesis about the view of point from SMEs in Thailand.

The information on nine new participants in Phase Three follows in Table 6.2

Table 6.2: Information of each company in Phase Three

Company	Interviewee number	Position in company	Company size	Product	Position in SCs	Type of company	Origin of Company	Location	Year Experience	
									@ Company	@ Industry
G	Interviewee 10	Asst. Manager Administration	Large	Tube in automotive	1st – 2nd Tier suppliers	Automotive industry	Japanese company	Chonburi	>15	25
H	Interviewee 11	Factory Manager	Small	Air fitter, PE tape and insulation	1st – tier supplier	Electrical industry	Thai company	Samutprakan	11	30
I	Interviewee 12	Quality Management Representative	Large	Metal stamping and plastic injection	2nd – tier supplier	Automotive industry	Thai company	Bangkok	2	>20
J	Interviewee 13	Manager Engineering	Large	Print-circuit-board (PCB)	1st and 2nd – tier suppliers	Electrical industry	Korean company	Chachoengsao	5	10
K	Interviewee 14	Senior Operation Officer	Large	Auto Mirrors, Lamps and Plastic Parts for OEM.	1st, 2nd, and 3rd – tier suppliers	Automotive industry	Thai company	Samutprakan	>20	>20
L	Interviewee 15	Assistant General Manager	Medium	Electrical equipment	Focal firm and 1st – tier customers	Electrical industry	Thai company	Bangkok	2	>15
M	Interviewee 16	Program/Project Manager	Large	Hard disk drive parts and precision electronic devices	1st – tier supplier	Electronic industry	Japanese company	Ayutthaya	13	>15
N	Interviewee 17	Sr. Supply chain DIRECTOR	Large	Print-circuit-board (PCB)	Focal firm	Electronic industry	Multi-national company	Ayutthaya	>20	>30
O	Interviewee 18	Owner	Small	Air conditioner parts	Focal firm	Electrical industry	Thai company	Bangkok	>20	>30

6.2.2. Process for Phase Three

Regarding to Section 4.2.2 Process for Phase One, this thesis also applied same process from Phase One in Phase Three. Content analysis was used in this phase as same as applied in Phase One. The processes of Phase Three analysis are 1) tape recorder during interview section; 2) tape transcribed with the researcher note; 3) translated transcribed from Thai to English language; 4) all transcribed were imported in Nvivo programme, and then 5) all data were analysis with content analysis. Phase Three showed results and sought their opinions/views of the finding from Phase One and Two to validate and confirm the overall results.

As same as process in Phase One, the researcher would like to summarize themes from Phase Three (see Figure 6.1 for an example of interviewee's analysis); however, the researcher provides the sample process for interview analysis for this phase only. Moreover, content analysis was used in this phase as well.

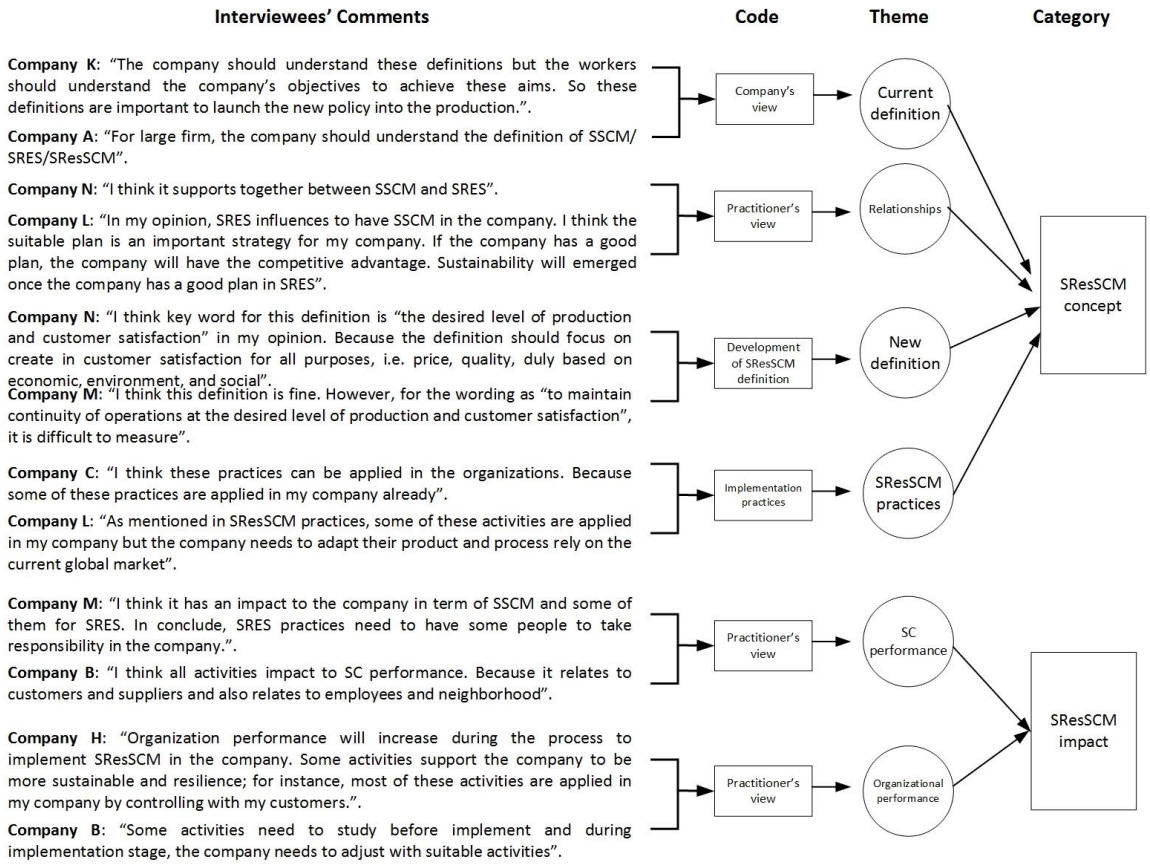

Figure 6.1: Examples of interviewee's analysis for Phase Three

Figure 6.1 presents an example for an analysis for Phase Three. This process was used as same as Phase One. The results from Phase Three used to verify and confirm the findings from Phase One and Two. The findings from Phase Three are presented in Section 6.2.3 to 6.2.7.

6.2.3. Current level of understanding and implementation of SSCM and SRES in organizations

The findings from Phase Three add more insights to the results from Phase One and Phase Two. Firstly, all participants highlighted the understanding of SSCM and SRES in their companies. Phase Three also confirmed that the understanding of SSCM and SRES concepts was very important for the companies because it would help the employees to work with more understanding of their position or responsibility. Moreover, it can be seen that most of the companies thought that top management needed to understand these concepts before implementing them in company policy. Top-down communication supports the understanding of these concepts from top management down to all employees. In addition, it was evident that there are clear definitions of SSCM, rather than SRES in Thai manufacturing. However, Phase Three showed that SRES rather than SSCM practices were implemented in companies. Moreover, the results suggest that the SSCM concept in companies was developed from the definition in the literature, whereas SRES concept in companies was developed from past experience. Hence, the levels of SSCM and SRES differed between the companies, depending on their experience. Consequently, if companies can provide clear concepts of SSCM and SRES for their employees, it will enhance the understanding of their employees in working towards the company's goals.

Secondly, Phase Three also confirmed the results from Phase Two, as the researcher found that the understanding of the SResSCM definition did not have a direct relationship with the implementation of SResSCM practices. All companies agreed with this, using different comments. For instance, Company C mentioned that their employees had to apply procedures from top management's policy without understanding the SResSCM concepts, so they would not understand the

goal of SResSCM as part of top management's purpose. Then, top management should adapt employees' feedback to adjust the procedures or policies of SResSCM in the company. Moreover, Company F considered that top management should understand the SResSCM concept before implementing it as company policy, and provide more knowledge about SResSCM to their employees. In addition, Company I believed that supervisors should take more action to remind their workers about the SResSCM concept and thus gain more improvement from the employees. However, Company K thought it would be difficult to implement new things in the company, because it would impact on current practice, and make more work for the employees. Therefore companies should provide knowledge or clear concepts of SResSCM to their employees during the implementation of SResSCM practices. Company M believed that because they did not have good communication with their employees, their employees would not understand the SResSCM concept well enough. Thus, companies should provide more knowledge and understanding to their employees to enhance their performance. However, Company O argued that the definitions of SSCM, SRES and SResSCM concepts are not important for small companies, but are important for large companies. Therefore, top management should study and prepare to implement SResSCM by applying employees' feedback to enhance suitable SResSCM practices within their company. The current implementation level for each company as presented in Table 6.5.

Lastly, the results concerning the relationship between SSCM and SRES are categorized into three main ideas, as i) SSCM is a major concept and SRES is a minor concept (35.71%), ii) SRES is a major concept and SSCM is a minor concept (35.71%), and iii) SSCM and SRES are joint concepts (28.57%). There are some arguments from Phase Three, which support the results from previous phases. For example, Company C argued that when sustainability policy was good, it would increase performance in resilience. Moreover, Company L thought that SRES influenced the desire to adopt SSCM in their company. Moreover, Company D speculated that there was an indirect impact rather than direct impact between SSCM and SRES, and while it could not support each concept separately, it could support a combination of both. Thus, the relationship between SSCM and SRES

from the practitioner's perspective depends on past experience and is also related to the company's policy of focusing on different concepts, i.e. SSCM or SRES.

In summary, SSCM and SRES concept and practices, which related to this thesis, were implemented in the company in some practices already. However, it can be concluded that the understandings of SSCM and SRES concept are not relate to implementation practices in company. Therefore, companies should provide more information to their employees to gain more benefits from SResSCM concept from this thesis.

6.3 An SResSCM framework from structured interviews

Phase Three argued about SResSCM definition, which was developed from the literature and previous phases and provided by the researcher, as "SResSCM means the management of materials, information, and capital flows along the supply chain with three dimensions, being environment, economic, and social perspectives, by integrating resilient practices to enhance supply chain performance for different periods of time to maintain continuity of operations at the desired level of production and customer satisfaction" (Please refer this definition in Appendix C, Section B, Question 3). Most companies reviewed and explained this definition in relation to their own experience, to enhance the meaning of SResSCM definition. Some suggestions arose during Phase Three. For instance, Company N trusted that the main keywords in this definition were "the desired level of production and customer satisfaction", so the company should pay attention to price, quality and duty, based on economic, environmental, and social issues. Meanwhile, Company M thought that "the desired level of production and customer satisfaction" was difficult to measure. Therefore the company should define the scale on which to measure SResSCM in different periods of time if possible. Furthermore, Company O suggested that SResSCM definition should integrate total resources; i.e. material, operational, human, technological, financial and marketing to operate the business. In addition, Company G advised focusing on cost reduction within the SResSCM definition, as cost reduction was currently one of the important KPIs for the

company. Company B thought that SResSCM definition could be used to support customers by developing production inside the company, so the company should apply SResSCM to link with customer requirements.

However, Company K thought that SSCM and SRES had different objectives, so it would be quite difficult to integrate these two concepts into one definition, but if the company could define a clear concept between these two objectives, it would help it to implement SResSCM practices with more efficiency and effectiveness. Furthermore, Company I believed that the SResSCM definition should focus on people/employees as well, because if the company had good procedures or policies which their employees did not understand, it would not help the company to be more sustainable and resilient. In the meantime, Company F suggested that the company should first focus on social perspectives, and then on environmental and economic elements, respectively, because SResSCM definition should relate to the action of employees/people rather than other aspects. Company I advised that SResSCM should add people and connection into the definition before implementation in the company with two-way communication because it would help the company to operate using more efficient practices. Moreover, Company A recommended that SResSCM definition should take place within supply chain because SResSCM will involve different actions according to different points of view. Thus, SResSCM should have a clear point of focus.

The last point for SResSCM definition is the meaning of different periods of time. As commented by Company D, the definition should offer a clear meaning of “different periods of time” in the final definitive version of “SResSCM”. Moreover, Company D suggested revising the definition of SResSCM from “operation” to “its business” by focusing on Business Continuous Plan (BCP), and that the company should have an action plan related to their commitment to green production procedures, i.e. for both the current period and disruption period, to maintain sustainability and resilience throughout the supply chains as well.

Consequently, definition of SResSCM will guide companies in operating their businesses with as much sustainability and resilience as possible. However, this depends on the level of SResSCM applied by the company. Hence companies should study and implement SResSCM once their employees or workers are ready to benefit from the concept. Even though, Phase Three confirmed that SResSCM definition and practices can usefully be applied in companies, but they might need to review some studies before implementing SResSCM practices. For example, Company G and H mentioned that the SResSCM definition from this study quite similar to their current production procedures, so they believed that SResSCM from this study could be applied in the real world.

Various suggestions arose from Phase Three. Company A suggested that the company should have SResSCM policy as their minimum policy of sustainability and resilience practices to enhance business contingency plans for future disruptions. Company D suggested that the company should provide a good strategy for their suppliers and customers by reducing constraints and risk for their business. Thus, collaborations between the supply chains represent a major factor for SResSCM.

However, Company C thought that SResSCM definition combined with substantial factors, i.e. environment, economic and social, and that there were some conflicts between these factors themselves, so the company needed to define their own goals clearly before implementing SResSCM. Furthermore, Company F advised that suitable SResSCM practices were adopted by companies at different levels, so each one needed to examine the most suitable SResSCM for their company. Besides, Company J suggested that top management should state their aims for implementing SResSCM to their employees, and offer activities that would increase more understanding about SResSCM to their employees during the implementation of these practices. In addition, Company L believed that the clear definition of SResSCM is the key point to implementing these practices in the company. Moreover, Company N thought that SResSCM was easy to talk about with customers, but difficult to apply in the company.

Consequently, SResSCM concept in this thesis can be applied in company, especially in developing nations as Thailand, because it will support companies to improve their performance in term of sustainable and resilient in supply chain management at the same time. However, as mentioned in Section 6.2.3, the company should provide a clear definition or concept to their employees. Therefore, the development of SResSCM framework will be discussed on Section 7.2.2 by combining the findings from literature review and results from Phase One to Phase Three of this thesis.

6.3.1. SResSCM practices measurement scale ranking

Based on the results from the survey of this study, it can be seen that there are 16 SResSCM practices, as stated in Section 5.3.4.4 and Table 5.13, which can be used to measure sustainable and resilient implementation levels in a company. These practices should be applied to enhance organizational performance and supply chain performance in sustainability and resilience perspectives. As the objectives of this thesis are to study and develop SResSCM concept and to test appropriate SResSCM measures for organizations and supply chains. Then, the researcher would like to study and define that which SResSCM practices are most importance from practitioner's perspective. So, Phase Three interviewees were asked to rate the score of the 16 SResSCM practices into two objectives: (i) all interviewees rated the number from 1 to 10 related to practitioners' perspective in each SResSCM practices, with 10 being the most important, coding the results of Phase Three's answers as 1 – 4 points means "less important", 5 – 7 points means "somewhat important", and 8 – 10 means "very important" and (ii) all interviewees selected implementation level option with 5 Point Likert's scale on the level of implementation of each practice, where 1 means "Not considering"; 2 means "Planning to consider"; 3 means "Considering it currently"; 4 means "Initiating implementation" and 5 means "Implementing successfully" related to their company's practices.

All of sixteen SResSCM practices were identified from Phase Two that these practices are suitable to implement in organizations to improve performance to be more sustainable and resilient at the same time. Therefore, in Phase Three, the researcher needs to validate and confirm the results from previous phases and to identify important SResSCM practices from practitioner's perspective. Moreover, this phase would like to present SResSCM practices, which were implemented in organizations already, to support that these practices could be applied in organizations. The results for this objective will help the researcher to summarize that which sub-level of SResSCM practices are importance and most of practitioners are interesting on which practices.

Table 6.3: Descriptive analysis of SResSCM variables

Rank	Variables	Not important	Less important	Somewhat important	Very important	Mean	Std, Dev	Level of implementation
1	IEP _01	0.00%	0.00%	0.00%	**100.00%**	9.786	0.579	Implementing successfully
2	IEP _07	0.00%	0.00%	7.14%	**92.86%**	9.571	1.158	Implementing successfully
3	IEP _04	0.00%	0.00%	0.00%	**100.00%**	9.214	0.975	Implementing successfully
4	IEP _05	0.00%	0.00%	7.14%	**92.86%**	9.071	1.439	Implementing successfully
5	IEP _03	0.00%	7.69%	7.69%	**84.62%**	8.846	2.641	Implementing successfully
6	IEP _02	0.00%	0.00%	7.14%	**92.86%**	8.786	1.251	Implementing successfully
7	IEP _08	0.00%	0.00%	35.71%	**64.29%**	8.429	1.742	Implementing successfully
8	IEP _06	0.00%	0.00%	35.71%	**64.29%**	8.000	1.519	Initiating implementation
8	IR_01	0.00%	7.14%	28.57%	**64.29%**	8.000	2.320	Implementing successfully
10	IR_03	0.00%	7.14%	28.57%	**64.29%**	7.929	2.786	Implementing successfully
11	ECO_02	0.00%	7.69%	38.46%	**53.85%**	7.923	2.326	Initiating implementation
12	COL_02	0.00%	14.29%	21.43%	**64.29%**	7.857	2.656	Initiating implementation
13	IR_02	0.00%	16.67%	16.67%	**66.67%**	7.750	3.137	Initiating implementation
14	ECO_03	0.00%	15.38%	23.08%	**61.54%**	7.538	2.933	Implementing successfully
15	COL_01	0.00%	35.71%	35.71%	28.57%	5.357	3.365	Considering it currently
16	ECO_01	0.00%	38.46%	38.46%	23.08%	5.154	3.648	Considering it currently

Table 6.3 presents the ranking, percentage, mean, standard deviation and level of implementation of 16 SResSCM practices from the practitioner's perspective. It may be concluded that there are some practices that are believed to be very important in the company in operating their business to be more sustainable and resilient in the supply chains in Thailand. Ten SResSCM practices were implemented successfully, four SResSCM practices were at the initial implementation stage, and two SResSCM practices were currently considering it in the structured interview section. There were 12 practices, which were important to the company: IEP_01-

08, IR_01-03, ECO_02, ECO_03, and COL_02. Only ECO_01 and COL_01, showed "less important" and "somewhat important" at the same level. Then, the researcher concludes that if organizations would like to implement SResSCM practices in some areas first, they might study and implement SResSCM practices from Rank 1 to 5 first, and then they can expand to implement in the lower rank respectively. Furthermore, Table 6.3 also confirms that these 16 SResSCM practices are currently used in organizations; so other organizations that did not implement these practices can ensure that these practices would be possible to use in their organizations.

Regarding the results of SResSCM practices ranking, there were some comments from the practitioners in each practice as follows:

- ***Rank 1*: IEP_01: The company implements basic requirements that customers request**

Most of the companies answered this question easily because it was standard policy to support customers by applying their requirements in production. For instance, Company I mentioned that they applied the customer's requirements based on ISO requirement. Moreover, Company A believed that IEP_01 was important for the company to operate their business with customers.

- ***Rank 2*: IEP_07: The company follows basic requirements of the Department of Labour for providing welfare and safety for employees**

Based on Department of Labour policy, most companies needed to apply and operate conforming to the standard requirements. For instance, Company H stated that their company "had teaching, training and providing more knowledge and information to their employees for enhancing their performance and labour skills". Moreover, Company B, G, I, J and M also confirmed that their company applied the basic requirements of the Department of Labour in their policy, some of them having more policy than the standard.

- ***Rank 3*: IEP_04: The company can quickly provide a formal response team of key personnel, both on-site and at corporate level.**

Most of the companies had contingency plans for unforeseen disruptions, because Thailand had suffered huge flooding in 2011. Therefore, the companies prepared plans for other disruptions, i.e. flooding, fire, earthquake, bankruptcy or terrorism. For example, Company N explained that the company had a programme for management, who would contact their customers during periods of disruption. In addition, Company G, I and J mentioned that their companies had plans for some major cases as contingency plans only. However, Company B stated that their company had a response team set up to deal with some cases, but this plan was not up-to-date, as the company did not use it enough.

- ***Rank 4*: IEP_05: The company uses customer feedback to develop their products/productions.**

Customer feedback was used to create more value for the company. This practice was applied by some companies in Thailand. For instance, Company I cited that the company had an Advance Product Quality Plan (APQP) to apply customer feedback and develop the quality of products. Furthermore, Companies J and N used customer feedback to enhance their performance and maintain the business between company and customers. However, Company C mentioned that while the company used customer feedback to achieve ISO, it did not affect the company's production processes.

- ***Rank 5*: IEP_03: The company follows Government/BOI legislation to conduct business using tax, or import-export criteria**

Regarding government legislation, most of the companies needed to follow the policy in Thailand. However, Company H added that the company had to follow other countries' legislation, where the products were sold. Company B, G, I, and J confirmed that the company applied government legislation in their policy.

- ***Rank 6*: IEP_02: The company takes immediate action to mitigate the effects of disruptions, despite the short-term costs**

Due to unforeseen disruptions, certain actions were needed. There were some comments from Phase Three on this practice. For example, Company B mentioned that the company needed to support the customers first, and then prepare to recover their production later. Hence companies may need to invest in actions to support customers. Moreover, Company D explained that this practice was important but not in all cases (the company needed to review case by case before taking action). Company M trusted that IEP_02 was an important practice for the company at this moment. Company H stated that the company had this practice because once the disruption had occurred, customers always required a plan to overcome the disruptions.

- ***Rank 7*: IEP_08: The company's suppliers receive information about customer requirements to support the production in the company.**

The connectivity between suppliers, manufactures and customers was an important factor in the supply chains. This practice was one of most important factors in overcoming the disruptions in supply chains. Company B explained that the company sent the customers' requirements to their suppliers to ensure production ran smoothly. Company C mentioned that the company shared important information with the customers as well. However, Company N argued that the company had shared information with the supplier, but they were not sure about the results of sharing this information.

- ***Rank 8*: IEP_06: The company has a contingency plan for unforeseen disruptions *and* IR_01: The company audits their waste disposal companies to ensure it processes waste correctly**

Contingency plan was one of the practices that the company should prepare for to prevent any risk. However, the contingency plan is related to the company's past experience. For example, Company G mentioned that the company had a contingency plan, but only for some, and not all cases. Company J also stated that the company had a contingency plan in some cases related to the production of the

company. Company N argued that contingency plan depends on different situations, so the company adopted it for major cases only.

Furthermore, IR_01 practice was used to support the company in terms of investment recovery. This practice was forced on the company by the Government or customers. For instance, Company B stated that their customers required them to dispose of their waste correctly, so the company needed to use waste disposal companies to make sure that their waste was properly disposed of. Company G explained that the company used certificated waste disposal companies only to dispose of their waste.

- ***Rank 10*: IR_03: The company sells scrap and used materials to certified waste disposal companies**

Due the hazardous materials produced during production processes, the electrical, electronic and automotive industry companies needed to dispose of their waste via certified waste disposal companies. Most companies had already been applying this practice (Company B, J, M and N). However, some companies produced less waste, so used standard waste disposal methods only (Company I).

- ***Rank 11*: ECO_02: The company designs products that focus on the reduction of resource consumption and waste generation in product usage**

For manufacturers, ECO-designed new products with less resource consumption were the goal of the company. As mentioned by Company B, the company had goals and policies to reduce consumption, related to the requirement of customers, so needed to design new products with less consumption. Furthermore, Company G thought that if the company could reduce resource consumption, they would gain more profit. Company H argued that this practice related about 40% to company policy, and 60% to customer requirements. However, as a contract manufacturer, Company N could not apply this practice, because products were designed based on the customers' designs.

- ***Rank 12*: COL_02: The company communicates important information to their suppliers and customers for unforeseen disruptions**

Some companies supported their suppliers and customers by providing important information during unforeseen disruption periods. For example, Company B shared information between suppliers and customers in certain cases. Company G only supported some suppliers or customers, while Company H shared information with their suppliers and customers in all conditions, preparing an incidents plan, together with possible actions. However, Company I and J mentioned that their companies did not have this practice in their policy.

- ***Rank 13*: IR_02: The company uses the policy of the Board of Investment (BOI), Thailand as procedures for waste disposal**

Most companies needed to follow policies based on the Department of Industry directives. Some companies had already been applying this practice in their procedures (Company B, I, J, M and N). In contrast, Company H argued that the company did not have this practice in its production process.

- ***Rank 14*: ECO_03: The company adopted environmental concerns when designing their products/processes**

ECO-design with environmental concerns is one practice that enables a company to be more environmentally friendly. There were some comments arising from this section. For instance, Company G mentioned that the company tried to reduce any hazardous materials in the production process in a way that related to customers' requirements. Company C explained that the company was obliged to follow the legislation of the country where the products were sold, so tacitly needed to apply environmental concern in their production process. Moreover, Company B, H, I, J and M had already been applying this practice in their production. However, Company N did not use this practice, due to the company needing to produce products based on customers' designs.

- ***Rank 15*: COL_01: The company's customers are willing to delay orders when the company's production capacity is hampered**

For this practice, Phase Three explained that most customers were not willing to put up with any delays, so it was difficult for a company to implement this practice. As commented by Company C, "any delays from the company are our problem; it is not customers' issues, so the company needs to solve it by itself". Company H mentioned that the company needed to prepare contingency plans to avoid any delays for customers, because their customers were not willing to accept delay. Company J and N argued that the company needed to communicate with customers about any delays, and to solve the problem together. Moreover, Company G explained that if the company suffered delays, their customers would find other sources instead, so the company needed to support its customers as much as possible.

- ***Rank 16*: ECO_01: The company designs products that can be re-used and recycled.**

The last rating of SResSCM practices in this study is ECO_01, as most of the companies in this study were in the electrical, electronic and automotive industries, where many products cannot be re-used or recycled. Therefore, Phase Three indicated that this practice was not important in their perspective. However, some comments emerged from this practice during the interview section. For instance, Company H mentioned that the company tried to produce products that could be re-used and recycled for some customers. Company J and N explained that their products were designed by their customers, so they could not design the products themselves. Moreover, Company G argued that their products could not be re-used or recycled at all, but simply needed to be scrapped. Company B stated that this practice related to the nature of the product; some products could be recycled, some of them just needed to be scrapped, although they needed to be of some use before scrapping.

Furthermore, Phase Three had some suggestions for enhancing SResSCM practices in companies. Company A suggested that the company should look at SResSCM in

the bigger picture, rather than in individual sections, because supply chains should relate to both suppliers and customers. Moreover, Company G advised that SResSCM could be measured by reviewing the awards from the Government that are a well-known prize in Thailand. In addition, Company H mentioned that companies should do everything they could to comply with ethical issues, and that this should also apply to SResSCM. Lastly, Company O advised that SResSCM depends on the culture of the company, so top management should understand their culture first, and then apply suitable SResSCM practices for the company, respectively. Thus, these measurement scales of SResSCM practices could be used to measure the implementation level of SResSCM in the future. These comments from Phase Three will help to guide other companies in implementing SResSCM practices.

In summary, Phase Three confirms that the implementation level measurement scale of SResSCM practices from this thesis, can be used to measure organizations about current implementation practices that will guide organizations to study in some practices, which will help to improve more sustainable and resilient in the future.

6.3.2. SResSCM practices impact on supply chain performance

Based on Phase Two results, it can be seen that SResSCM practices have impact on supply chain performance and organizational performance. Therefore, in Phase Three, all companies were asked to rank the impact of SResSCM practices on supply chain performance regarding four main factors, as demonstrated in Section 5.3.4.5 and Table 5.17: 1) customer and operational cost (COC), 2) environmental cost (ENV), 3) business wastage (BUS) and 4) customer satisfaction (CS), as question 10 in Appendix C, Section B. For this process, the researcher presented the results from Phase Two and explained to all interviewees that “when organizations implemented SResSCM practices successfully, it will be improved supply chain performance into four main factors as COC, ENV, BUS and CS, so please help to rank the most important factors from practitioners’ perspective from 1 means most

important SC performance in organizations and 4 means less important SC performance in organizations".

Therefore, the results from Phase Three showed that customer satisfaction (CS) was the number one factor in supply chain performance that the practitioners believed to be most important for the company, because the customers were the main point for the company to do business; therefore if the customers were satisfied with the company, they would do business with the company for a long time. Ranked number two was customer and operational cost (COC), because companies mentioned that if the company could control operational cost, they would earn more profit. The third most important factor in supply chain performance was business wastage (BUS), because, as Phase Three shows, if the companies could reduce waste, they would gain more profit and work more smoothly than before. The last factor that was less important from the practitioner's perspective was environmental cost (ENV), because they believed that sustainability and resilience in the supply chain had already been applied by company environmental policies. Environmental cost would hence impact SResSCM respectively, and was believed to have less likely impact compared with the other factors. This process helps the researcher to identify that which SC performance variables are most important in practitioner's point of view and it will attract other organizations to implement SResSCM practices in the future by using this thesis for their development plan. Figure 6.2 presents the results of this performance rating.

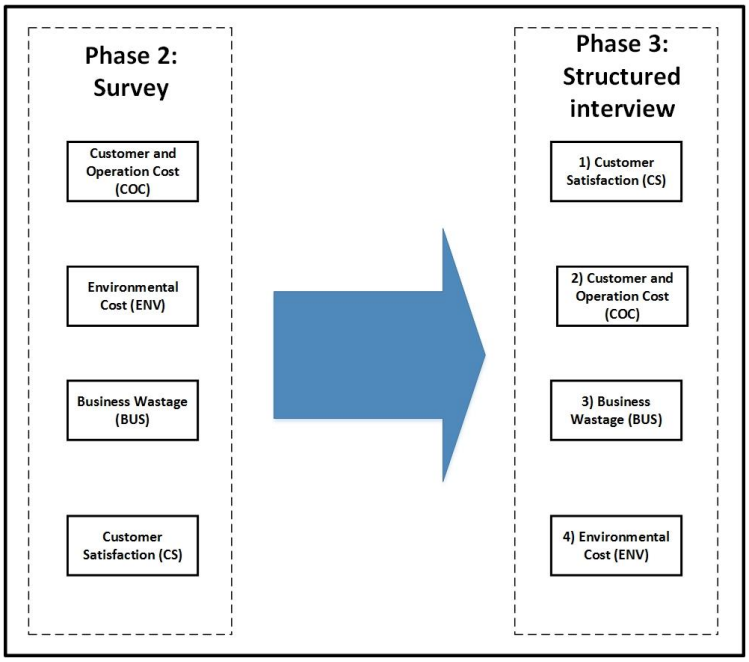

Figure 6.2: SC performance rating

Furthermore, Phase Three also ranked the importance of each supply chain performance variable from the survey results. The 24 SC performance variables from existing theory and semi-structured interviews (Phase One) were selected and reduced by the survey result to 15 SC performance variables, as shown in Table 5.18. The remaining SC performance variables were presented and rated from 1 to 10 with 10 being the most important, regarding to question 11 in Appendix C, Section B. Once Phase Three had answered this question, the results were coded and transformed into three levels as: 1 – 4 points means "less important", 5 – 7 points means "somewhat important", and 8 – 10 means "very important". Furthermore, all companies were asked to rate their perspective in terms of how far SResSCM practices influenced improvement in SC performance in each variable using 5 points Likert's Scale, from 1 means " strongly disagree" to 5 means "strongly agree". As the researcher explained to all interviewees that "after conducted the survey, the results showed that when organizations implemented SResSCM practices, it will provide some impacts to organizations, so do you agree or disagree with these results?" Therefore, all interviewees completed this question by themselves.

Table 6.4 presents the ranking, percentage, mean, standard deviation and practitioner's perspective for each SC performance variable. It was found that 13 SC performance variables were very important from the practitioner's perspective in Thailand (based on the standard level of higher than 60, as this study covered 64.29% - 100%). There were two SC performance variables, as COC_02 and ENV_02, being less than 60% of the total respondents.

Table 6.4: Descriptive analysis of SC performance variables

Rank	Variables	Not important	Less important	Somewhat important	Very important	Mean	Std, Dev	Practitioners' perspective
1	COC_04	0.00%	0.00%	0.00%	**100.00%**	9.429	0.852	Strongly Agree
2	COC_03	0.00%	0.00%	0.00%	**100.00%**	9.214	0.975	Strongly Agree
3	BUS_02	0.00%	0.00%	7.14%	**92.86%**	9.143	1.460	Strongly Agree
4	COC_05	0.00%	0.00%	7.14%	**92.86%**	9.071	1.072	Strongly Agree
5	BUS_03	0.00%	0.00%	14.29%	**85.71%**	8.929	1.385	Strongly Agree
6	ENV_03	0.00%	0.00%	28.57%	**71.43%**	8.643	1.598	Strongly Agree
7	COC_06	0.00%	0.00%	21.43%	**78.57%**	8.500	1.912	Strongly Agree
8	COC_01	0.00%	0.00%	21.43%	**78.57%**	8.429	1.604	Agree
9	ENV_01	0.00%	7.14%	14.29%	**78.57%**	8.357	1.946	Strongly Agree
10	ENV_04	0.00%	0.00%	28.57%	**71.43%**	8.286	2.054	Strongly Agree
11	CS_01	0.00%	7.14%	28.57%	**64.29%**	8.071	2.056	Agree
12	CS_02	0.00%	7.14%	21.43%	**71.43%**	8.000	1.840	Agree
13	COC_02	0.00%	14.29%	28.57%	57.14%	7.643	2.134	Agree
14	ENV_02	0.00%	7.14%	35.71%	57.14%	7.571	2.243	Agree
15	BUS_01	0.00%	21.43%	14.29%	**64.29%**	7.500	2.534	Strongly Agree

The top five most important SC performance variables are 1) COC_04, 2) COC_03, 3) BUS_02, 4) COC_05 and 5) BUS_03. The top five SC performance variables related to SResSCM are 1) COC_04, 2), BUS_02, 3) ENV_04, and 4) ENV_03 and BUS_03, which strongly agreed with all of these variables. Regarding the results of SC performance ranking, there were some comments from Phase Three for each practice as follows:

- ***Rank 1*: COC_04: The company increased the amount of goods delivered on time**

This variable was the most important SC performance variable from the point view of practitioners, who also strongly agreed that SResSCM practices, helped to improve this variable in the company. Company B, G, I and J strongly agreed that

COC_04 was important and SResSCM practices helped to improve performance in this respect. Moreover, Company H and N also mentioned that this variable was their KPI, so they always pay attention to this element by providing policy to support it. However, Company M believed that SResSCM helped to support this variable but was not the key factor; rather it appeared to be a minor factor in improving this variable.

- ***Rank 2*: COC_03: The company can decrease expenses of materials purchasing**

Reduction in expenses on materials purchasing was another important element in performance from the practitioner's perspective in Thailand. Company G, H, and I strongly agreed that it was very important in their company. In addition, Company J 100% agreed that SResSCM helped to improve performance. However, Company B thought that this area of performance related to the number of orders rather than company practice, and was based on order fulfilment in the production process.

- ***Rank 3*: BUS_02: The company increased product quality**

Company B, G and H strongly agreed that SResSCM practices helped to improve product quality in the company. Moreover, Company I stated that SCs enabled the company to access good materials, which, in turn, would help it to produce good products. By contrast, Company J thought that the improvement of product quality related to their customers rather than SResSCM policy.

- ***Rank 4*: COC_05: The company can decrease inventory levels in their warehouse**

Most of the companies strongly agreed that SResSCM practices helped to reduce inventory levels. As mentioned by Company I, if the company had good SCs, it would control inventories more easily. Furthermore, Company N explained that this was an important performance element that the company needed to monitor, because inventory is a cost to the company. Company H mentioned that SResSCM had helped their company to control their inventory for the last three years. However, Company B explained that while SResSCM helped to support the

company in finding good materials from good sources at good prices, it was good production planning that helped the company to use and manage their inventory.

- ***Rank 5*: BUS_03: The company can decrease its scrap rate**

Phase Three indicated that this performance element was important to companies. As stated by Company B, if the company had a good plan for supporting customers in this area, it could reduce waste more effectively than previously. Company G, H, and N strongly agreed that SResSCM helped to decrease the rate of scrap in their company. Moreover, Company J suggested that the company should improve knowledge or labour skills to decrease scrap rates.

- ***Rank 6*: ENV_03: The company has increased its production line**

Some of the companies noticed improvement in this aspect of performance if they applied SResSCM in their policy. In addition, Company H explained that if the company could do business smoothly, it would help to enhance their performance. Company I argued that in their opinion, good SCs could increase the rate of production line. However, Company B commented that this performance aspect was difficult to measure.

- ***Rank 7*: COC_06: The company developed an effective strategy for communication in a variety of extraordinary situations**

In Phase Three 78.6% of interviewees thought that this performance was important in their view, and they strongly agreed that SResSCM practices helped to prepare effective strategy for communication during unforeseen disruptions in the company. Company H mentioned that it would be a good thing if the company prepared some contingency plans for unforeseen disruptions. Company N thought that effective strategy was more important for their production than other elements. Company J mentioned their companies used the application “LINE” to communicate within and outside the company when disruptions occurred.

- ***Rank 8*: COC_01: The company improved capacity utilisation**

Phase Three agreed that SResSCM helped to improve capacity utilization, which was very important to the company (78.6%). However, Company I believed that SResSCM was not the main key point, because capacity related more to people and machinery than SResSCM, which helped to provide materials. Moreover, Company D argued that this performance related to SSCM only (rather than to SRES). Company A suggested that the wording here might be changed from capacity utilization to efficiency utilization, due to capacity relating to demand.

- ***Rank 9*: ENV_01: The company can decrease expenses for waste discharge.**

Phase Three strongly agreed that SResSCM helped to decrease expenses on waste discharge, and also that this performance area was very important for their company. Company I cited that because the company selected and used environmentally friendly products, it could reduce expenses by this action.

- ***Rank 10*: ENV_04: The company can decrease expenses for environmental accidents**

A total 71.4% of interviewees found this performance to be very important in Thailand, and the results also showed that the companies strongly agreed that SResSCM helped to decrease expenses on environmental accidents. As Company B explained, “I agree with this SC performance variable because if the company still does not implement SResSCM practices, accidents will keep going up; by the way, once the company has implemented these practices, accidents will decrease”. Moreover, Company I suggested that the company should train their employees to prevent any accidents first, and then monitor reduction of expenses on environmental accidents accordingly.

- ***Rank 11*: CS_01: The company increased the outsourcing of materials by various suppliers**

Most of Phase Three thought that CS_01 had a very important role for the company, and agreed that SResSCM helped to improve CS_01. Company H agreed

with the comment, “because the company needs to have alternative sources to prevent any concerns”. Company B mentioned that it did not increase the number of suppliers, but found alternative suppliers more than previously. However, Company A argued that SResSCM was not related to CS_01.

- ***Rank 12*: CS_02: The company increased a large number of members in supply chains**

CS_02 was a very important element in SC performance from the practitioners’ perspectives, and they also agreed that SResSCM helped to increase the number of members in the supply chains. Company N stated, “In practice, the company tries to increase the number of customers but decrease the number of suppliers”. However, Company A argued that SResSCM did not support CS_02 in the company.

- ***Rank 13*: COC_02: The company can decrease expenses on energy consumption**

COC_02 showed a “somewhat important” score in Phase Three because some of the companies believed that it was more related to the production process than SResSCM policy (Company G). Moreover, Company J argued that expense on energy consumption depended on ordering and forecasting during the production process.

- ***Rank 14*: ENV_02: The company can decrease effluent waste**

Some of companies did not use water in their production processes, so this type of performance element was quite difficult to measure compared with other aspects. However, some companies tried to reduce effluent waste. For instance, Company J mentioned, “The company re-used water in the production line and returned it to use again”.

- ***Rank 15*: BUS_01: The company can decrease consumption of hazardous materials**

Ranking last in SC performance, BUS_01 was less important than other SC performance elements in this study. However, Phase Three strongly agreed that SResSCM practices could decrease consumption of hazardous/harmful/toxic materials. For instance, Company H stated, "I strongly agree because the standards from Government/customers will force the company to apply this performance in the product/production". Moreover, Company J also commented, "I strongly agree because some of materials were reduced or eliminated from production".

In conclusion, it can be confirmed from Phase Three results that practitioners also agree with the results from Phase Two, which is SResSCM practices can improve SC performance in organizations. Moreover, this phase also highlighted SC performance variables that practitioners thought that it is important for organizations and attract other organizations to implement SResSCM practices from this thesis to achieve better SC performance in the future.

6.3.3. SResSCM practices impact on organization performance

Moreover, Phase Three included a discussion on the relationship between SResSCM practices and SResSCM impact from Phase Two, which was explained in Section 5.3.4.2.4 as: 1) sustainable and resilient supply chain management practices impact (SRESPI), 2) long-term organizational performance (LOP), 3) short-term financial (STF) and 4) short-term growth (STG). As same as process in Section 6.2.6, Phase Three ranked this relationship with the impact of SResSCM practices on their company, based on their perspective from 1 to 4, where 1 meant "highly impact" and 4 meant "least impact". This process will highlight impact factor to implement SResSCM practices in practitioner's point of view. Moreover, this process will alert organizations to prepare and plan for these impacts once they start to implement SResSCM practices in organizations. The results from Phase Three showed that the highly impactful factor of SResSCM practices on the companies was SRESPI, because they believed that if the companies needed to implement SResSCM in their policy,

it would surely impact on their practices generally both in the short-term and long-term.

The second impact factor from Phase Three was STF and STG (with an equal score) because the companies believed that a company looks for short-term impact rather than long-term impact. The final impact factor, which was related to organizational performance, was LOP. Figure 6.3 shows the result of this rating.

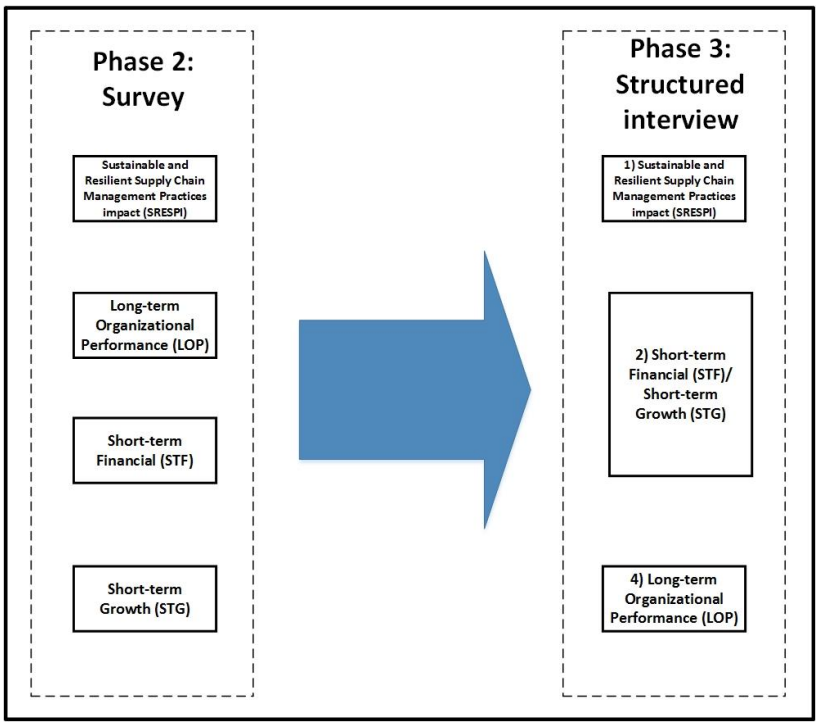

Figure 6.3: SResSCM impact rating

In this study, stakeholder theory can support the results from organizations on SResSCM practices. As Sarkis et al. (2011) noted, stakeholder theory has an impact on customers, suppliers, and shareholders, in term of internal and external which influence organizational practices, rather than individual section. Thus, SResSCM practices in this study conducted stakeholder theory as a main section in the supply chain.

The companies also defined the difference between short-term and long-term impact in their understanding. There were some interesting points arising from

Phase Three. Company B mentioned that short-term signified contentment, and provided immediate impact on the company. However, long-term referred to sustainability planning. Company D argued, “In my opinion, long-term focuses on outcome from the practices, for instance, good BCP, good brand image or efficient product. By the way, short-term likes the company to invest immediately but we need to wait for the outcome of new activity”. Furthermore, Company I stated, “Short-term impact relates to procedures in the production process, which impact the company immediately. By the way, long-term impact has lower influence than short-term impact in my opinion”. Company L believed that short-term was easier to solve problems, but if the company could not solve problems in the short-term, they would impact on the long-term. Company N explained, “Short-term is contentment and long-term is prevention, which can apply in all conditions. I think normally the company can answer short-term easier than long-term”.

On the other hand, some of the companies defined short-term impact and long-term impact by periods of time. For instance, Company A mentioned, “Short-term should get the result within 2 years; by the way, long-term it might be an impact of about 3 – 5 years”. Moreover, Company C remonstrated, “For short-term (0 – 3 years), it means the incidents that impact on the company immediately; by the way, long-term means more than 3 years, or cannot predict at this time”. Moreover, Company C also stated that short-term was a sub-set of long-term performance, as long-term policy was also used to define short-term policy. Similarly, Company K mentioned, “Short-term means 1 – 3 years for increasing profits and goals, i.e. profit, or decrease consumption. By the way; long-term means the company’s plan for the next 5 years”. Furthermore, Company G thought that short-term was less than 5 years, while 6 – 10 years meant long-term. Moreover, Company M explained, “1 – 3 years plan is long-term in the technology market, and short-term impact is year by year”.

Consequently, it can be concluded that practitioners aware about the impact after implemented new practices or policy in organizations. In this phase, practices impact are the most important factor that organizations focus before they

implemented new practices; while long-term organization performance has less focus than other variables from Thai industry.

6.4 Phase Three overall results

6.4.1. SResSCM Definition

As mentioned in Section 6.3 concerning a suitable framework for SResSCM from Phase Three, it can be concluded that the definition of SResSCM from the literature review, semi-structured interviews (Phase One) and the survey result (Phase Two) was somewhat lacking or weak in implementing this framework in the company at this time. However, there were some suggestions that could help to improve this definition from the practitioner's perspective. Thus, this study will develop a suitable framework of SResSCM, which can be applied by companies. However, while this SResSCM framework could be used as the main concept for company policy, it might provide different practices for each company. For instance, large companies might apply the SResSCM framework in all processes, while small companies might apply it in some processes. Moreover, it can be summarized that SSCM policy was developed in the context of academic definition, while SRES policy was developed from the experience of each company. Thus, different companies might apply different levels of SResSCM practices.

Therefore, the SResSCM definition for this study could apply some of these suggestions:

- SResSCM definition should include total resources, i.e. materials, operational, human, technology, financial and marketing.
- SResSCM definition should include cost reduction as a KPI.
- SResSCM definition should be linked to customer requirements as well.
- SResSCM definition should focus on people or employees, who will take these practices in the company.
- SResSCM definition should clearly define its scope, i.e. individual company or SCs.

- SResSCM definition should define the meaning of different periods of time more clearly.

These suggestions will be applied in the final SResSCM definition in Chapter 7.

6.4.2. SResSCM Practices

Regarding Section 6.2.5, all companies were asked to rate the importance of each SResSCM practice. 16 SResSCM practices from Phase Two were rated in Phase Three. It can be seen that all companies thought that Internal and External Plan (IEP) practice was more important than other SResSCM practices. Ranked from 1 to 8 of SResSCM practices were IEP_01 to IEP_08. The companies selected Investment Recovery (IR) as the second most important practice (as IR_01-ranked 8, IR_02-ranked 13 and IR_03-ranked 10). The third most important practice was ECO_Design (ECO), with ECO_01-ranked 16, ECO_02-ranked 11 and ECO_03-ranked 14. The last practice was Collaboration (COL) with COL_01-ranked 15 and COL_02-ranked 12.

Furthermore, the level of implementation of SResSCM practices showed different levels in Phase Three. However, most SResSCM practices were successfully applied in the organizations, while there were some practices at the initial stages of implementation, or considering it currently. Thus 16 SResSCM practices in this study were already being applied in the organizations in Thailand.

6.4.3. SC Performance

According to Section 6.2.6, the research finding showed that Phase Three judged that customer satisfaction (CS) was the most important supply chain performance from the practitioner's perspective. This was followed by customer and operational cost (COC), business wastage (BUS) and environment costal (ENV), respectively.

Moreover, Phase Three also thought that SResSCM practices influenced companies to improve supply chain performance, with practitioner rating as "agree" and

"strongly agree" (as Table 6.4). Therefore, it can be confirmed that SResSCM practices result in better supply chain performance and organizational performance.

6.4.4. SResSCM Impact

As in Section 6.2.7, the findings presented practitioners' perspectives on SResSCM impact, as they thought SResSCM practices had the most impact on their own company practices (sustainable and resilient supply chain management practices impact: SRESPI). This was followed by Short-term Financial (STF) and Short-term Growth (STG), with the last factor being Long-term Organizational Performance (LOP).

Thus, Phase Three showed some impacts from SResSCM, but that it would influence different companies in different ways. A company would encounter these impacts once they had implemented SResSCM practices.

6.4.5. Issue for supporting SResSCM

According to Phase Three findings, there were some points derived from the practitioners' perspectives as follows:

1) SSCM and SRES are related.
2) Most practitioners focused on SResSCM practices, rather than SResSCM definition. However, it can be seen that top management should understand SResSCM definition, while employees or workers should apply SResSCM practices in the production process. Thus, people are the most important factor in the successful implementation of SResSCM practices
3) Most companies introduced SSCM based on legislation from Government or institutes, while they operated SRES based on their past experience.
4) Large companies could force their supply chain members to implement SResSCM practices. However, small companies might only apply some SResSCM practices, due to their budget or return on investment.

5) Customer satisfaction was the most important SC performance from the practitioner's perspective; and sustainable and resilient supply chain management practices (SRESPI) were the most impactful factor from practitioner's perspective.

6.4.6. Level of SResSCM practices implementation in the company

Based on the results from Phase Three, it can be concluded that the companies had different levels of implementation of SResSCM practices. Table 6.5 presents the overall level of implementation for Phase Three. It presents that most of companies have IEP practices in their policy or procedures; however, there was one company is still considering to implement this practice in their organization as Company F. Moreover, investment recovery also has interested to implement in organization, as there were nine companies, where have been implemented this practice in company already. Thus, Thai industry aware and focus to reduce waste from their production and to sell scrap and used materials to certified waste disposal companies, which related to the policy from Thai Government and Board of Investment than before. On the other hand, ECO-design and collaboration practices were implemented in some companies; however, it is a good sign from Thai industry that these companies begin to improve their performance to be more sustainable and resilient in the future and it will support Thailand to be good manufacturers for West countries.

Table 6.5: Company's level of SResSCM practices

Company	SResSCM practices			
	IEP	IR	ECO	COL
A	●	●	●	●
B	●	●	●	◖
C	●	●	◖	●
D	●	◖	○	●
F	○	○	○	○
G	●	●	◖	◖
H	●	◖	●	◖
I	●	●	●	X
J	●	●	○	◖
K	●	●	●	◖
L	●	○	◖	●
M	●	●	●	●
N	●	●		●
O	●	X	◖	◖

Note: X means Not considering; ○ means considering implementing this practice; ◖ means partial implementation of this practice; ● means full implementation of this practice

6.5 Suggestions from Phase Three on SResSCM

According to the last question of the interview protocol, all companies were invited to make suggestions for this study. It can be seen that SResSCM was currently important for the companies, and there were some comments from companies in this field are applied in this study, as follows:

Company A suggested that information should be shared between the SCs, i.e. suppliers, manufacturers and customers, by collaboration in a win-win situation. Company C advised that a company should study the pros and cons of SResSCM before implementing these practices. Because SResSCM, combined with SSCM and SRES, could conflict, companies should weigh factors related to sustainability and resilience in their production processes, and develop suitable SResSCM practices, depending on each company.

Company D suggested that SResSCM should be applied at policy level, and be forced by the Government to be more sustainable and resilient. If the companies

were controlled by Government, supply chains would improve their performance and would enable Thailand to be more sustainable and resilient than other countries in South East Asia. Furthermore, Company F thought that collaboration practice would help to improve performance between companies and their supply chains, i.e. suppliers and customers, if they collaborated in the same direction. Top management should provide a clear definition of SResSCM and their objectives for their employees or workers to ensure that SResSCM policy would be used in the right direction.

Moreover, Company H believed that the understanding of employees of the company's aims and objectives was most important, because if the employees understood these objectives, it would help to improve organizational performance and supply chain performance over the long-term. Legislation in Thailand remains weak, so the Government should help to review and support companies in becoming more sustainable and resilient as much as possible. In addition, companies should apply ethical issues in their production processes more than previously.

Company I also suggested that employees or workers in the company were key factors in improving organizational performance and supply chain performance, so companies should help their employees by providing new knowledge and labour skills first, and then enhancing collaboration between the company and their suppliers or customers.

In addition, Company J also focused on the improvement of employees or people in the company. They believe that SResSCM practices or policies needed to collaborate with their employees over some actions. They thought that if the company had good motivation among their employees, this would improve organizational performance and supply chain performance. Ethical issues were one factor that was important for the company, so they should introduce these in their policy as well.

Company K advised that the company should focus on customer requirements rather than other aspects. On the other hand, Company L suggested that communication within and outside the company was a most important factor for SResSCM. However, it could be difficult to communicate between SCs, so top management should provide suitable practices to improve skills and communicate between these factors.

Company M suggested that top management was the main team to implement SResSCM in the company, so they should support and provide resources for their employees to execute SSCM and SRES in the company. Moreover, Company N advised that companies should have rewards for their employees to motivate suggestions for new SResSCM activities or practices. Moreover, top management should provide clear concepts of SResSCM at policy level, and deploy SResSCM practices at all levels in the company.

Thus, these comments from Phase Three, which were integrated with the results from Phase One and Phase Two, could help to validate and confirm overall findings for this study. Accordingly, these suggestions from Phase Three are applied with the overall findings and are discussed in Chapter 7.

6.6 Summary of chapter

This chapter has indicated the findings from Phase Three (Structured interview) of this research, which is the final stage of the methodological triangulation approach for this study. The next chapter will discuss the research findings of the study (Chapter 7).

Chapter 7 DISCUSSION OF FINDINGS

7.1 Introduction

The main purpose of this study is to gain a better understanding of SSCM and SRES in practice and develop a new framework for sustainable and resilient supply chain management (SResSCM), which can be applied by practitioners and academia to enhance their supply chain by becoming more sustainable and resilient. This chapter discusses and summarizes the key findings from all three phases of the study by combining the results from each phase to conclude in each sub-research question, as presented in chapter 2. All participants in this study worked in manufacturing in Thailand, i.e. electrical, electronic, automotive industries and transportation organizations, which delivered finished goods on behalf of Thai manufacturing. All of these industries were important manufacturers in Thailand, which exported finished goods around the world, also as discussed in chapter 2. Thus, these industries were suitable for collecting data to confirm the results of this study. To answer the sub-research questions, a triangulation process and literature review was conducted as a methodological approach shown in Figure 7.1.

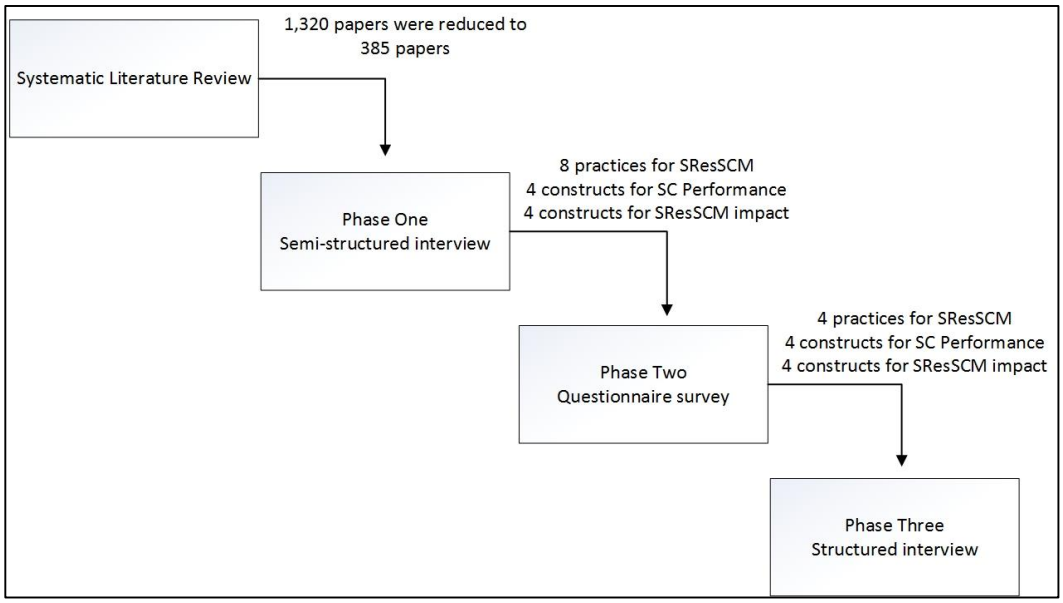

Figure 7.1: The triangulation approaches for this study

This chapter firstly discusses our current understanding of SSCM and SRES from the practitioners' perspectives. Secondly, it examines the relationship between SSCM and SRES to develop a definition of SResSCM practices. Thirdly, it discusses the valid measurement scale of SResSCM practices for performance measurement from all phases. Finally, it summarizes the impact of SResSCM practices on SC performance and organizational performance from this findings. This chapter then presents the key findings, based on three phases of research approach to summarize SResSCM definition and practices that organizations can apply to the concept, which can be used as a strategy of competitive advantage, and help to guide better policy in the future. This is a core contribution and output of this study.

7.2 Key empirical findings related to RQ1–RQ4

Regarding to literature review chapter, the researcher developed initial definition of SResSCM, as presented in chapter 2. Then, the researcher developed interview protocols from the existing literature to investigate the relationship between SSCM and SRES as discussed in Chapter 4: Phase One. The findings from Phase One were identified with four variables for SResSCM definition, 24 variables of SResSCM practices, 24 variables of SC performance, and 32 variables with four constructs for SResSCM impact, which were presented in Chapter 5: Phase Two. In total 84 SResSCM variables were empirically tested in the Phase Two survey, and were grouped after running EFA process on the four main groups as: i) four constructs as SResSCM Definition (four variables), ii) SResSCM practices (four sub-constructs – 16 variables), iii) SResSCM impact (four constructs – 32 variables) and iv) SC performance (four sub-constructs – 15 variables). Chapter 6: Phase Three then verified and validated the results from Phase Two from the practitioner's perspective. The next section will consider the findings in relation to each sub-research question (RQ1 – RQ4).

7.2.1. RQ1. What is the current level of understanding and implementation of SSCM and SRES in organizations?

RQ1 asked about the importance of SResSCM in an organization. The main purpose of this research question was to review the organization, where it applied SSCM

and SRES, and to study the understanding of these two topics from the practitioner's perspective. This helped to investigate why SSCM practices and SRES practices were important. From the semi-structured interviews (Phase One), the researcher investigated the understanding of SSCM and SRES in the practitioner's knowledge. Moreover, about 89% of respondents from the survey answered that the organizations had already been planning or implementing SSCM practices and SRES practices, while 62.5% of SResSCM practices were implemented successfully in organizations, as shown by the results from Phase Three.

Therefore, it can be concluded that Thai manufacturing has some knowledge about SSCM and SRES, but still needs to improve the understanding and knowledge flowing from academic to practitioner. There are lots of advantages to implementing SSCM and SRES in organizations in Thailand, because these concepts will enhance logistics and supply chain performance to be better than before. Government can support this improvement by providing suggestions or supporting knowledge sharing that can be used in Thailand, which related to Logistics Develop Master Plan. The empirical findings for this research question (RQ1) are explained below.

7.2.1.1 The understanding of sustainable supply chain management

This study applied the main concept of SSCM from Carter and Rogers (2008). The results from this study about the understanding of SSCM from the practitioner's perspective followed the same direction. As noted in chapter 4, participants from Phase One also mentioned that their organization had already applied SSCM in their policy and procedure; however, the organization did not offer a clear definition of SSCM, but they had practices that related to SSCM activities in the literature. Five out of six organizations implemented SSCM practices in their production processes (Table 4.3). For instance, some organizations applied ECO-design in their research and developed processes for new products, or developed their current products to be more environmentally friendly according to their competitors' or customers' requirements (Linton et al., 2007), as sustainability changed existing practices and

created a new production and management system. Further, all organizations had implemented green production in their policy at different levels, as partial or full implementation, in purchasing, production, warehouse or transportation (Kjaerheim, 2005; Veleva et al., 2001).

Moreover, most organizations in Phase One currently applied social responsibility as their policy, as related to Cruz and Wakolbinger (2008) and Sarkis et al. (2010). For investment recovery, as mentioned by Zhu et al. (2008), three organizations fully implemented this practice and two of them partially implemented it. However, one of them was "considering implementing" this practice in their organization's policy. Thus, the organizations in Phase One represented an understanding for SSCM, but in terms of implementation practices rather than understanding the definition. However, the results showed that most organizations knew that SSCM had an important influence on their business. Therefore, top management should have a clear idea or concept of SSCM and explain it to their employees, because the employees will then be aware of their responsibility and specific role in SSCM.

From the survey results (Phase Two), it can be seen that 85.62% of respondents explained that their organization had planned or implemented SSCM practices in their processes or policy (calculated from the survey with scale 2 (planning to consider) to 5 (implementing successfully in Section B). Most respondents selected "Scale 5: Implementing successfully" for ECO_01 (34.6%), ECO_03 (35.8%), GREEN_01 (36.7%), SR_01 (46.4%), SR_02 (74.1%), SR_03 (23.4%), IR_01 (76.4%), IR_02 (59.6%), and IR_3 (55.3%). Thus, most organizations in the survey had applied SSCM practices, which would improve performance both in the supply chain and their organization. By the way, there were two practices, for which most respondents selected: "Initiating implementation", as GREEN_02 (35.8%) and GREEN_03 (39.6%). Moreover, most respondents selected the "Not considering" option for "The company designs products that can be re-used and recycled (ECO_02, 23.8%)". Thus this practice was still being studied and processes developed to implement in the future. These results also confirm that the organizations adopted SSCM concept in their policy and had plans to improve SSCM

practices in areas of effectiveness and efficiency in the future, as organizations trusted that SSCM would help their production to be better than before.

As presented in chapter 6, Phase Three results showed that the organizations understood the definition of SSCM more than the definition of SRES; however, organizations adopted SRES practices more frequently than SSCM practices. Furthermore, this study found that most of the organizations applied SSCM practices from the literature, while they developed SRES practices from their experience in the past. Thus, top management was a key driver in pushing SSCM and SRES concepts in the organization. Moreover, top-down communications would help to support the employees' understanding of the organizations' goals in SResSCM. Nevertheless, bottom up communication would help the organizations to develop their goals in SResSCM.

Consequently, it can be seen from these three phases of research methodology that the organizations had applied the SSCM concept in their goals and policy to generate SSCM practices; however, the employees in the organizations had less understanding about the concept of SSCM from the literature. This shows that employees followed their organization's policy with no understanding of SSCM concept, but they still achieved their goals.

7.2.1.2 The understanding of supply chain resilience management

There have been lots of SRES definitions in academia however Thai manufacturing does not have much understanding of the concept; the definition of SRES was less understood in organizations than SSCM according to the results from Phase One. However, most of the participants had plans for unforeseen disruptions, having experienced the huge flooding in Thailand in 2011. Following that period, the organizations generated plans in preparation for more unforeseen disruptions that could happen in the future. Furthermore, Phase One demonstrated that the SRES concept was an important strategy for organizations that related to their suppliers and customers. As demonstrated in Table 4.3, it can be seen that most of the

organizations applied SRES practices in their policies and procedures more than SSCM practices, even without knowing much about SRES. These SRES practices would help the organizations to do business during unforeseen disruption with the best possible alternative solutions.

Moreover, as presented in Table 5.3, the results from the survey showed 92% of respondents had SRES practices in their organization in different stages of planning, from the considering stage to the implementing successfully stage. Most of respondents selected "Implementing successfully" for all SRES practices, with percentage from 33.3-75.2%. Thus, SRES practices were applied in the organizations to enhance their supply chains by being more resilient.

The results from Phase Three showed that most SRES practices from Phase Two (survey), i.e. IEP and COL, had already been applied in the organizations. As presented in Chapter 6 (Table 6.3), it can be seen that IEP_01 – 08 were implementing it successfully, while COL_01 and COL_02 were still considering it, or initiating the implementation stage, respectively. However, the participants suggested that the organizations should investigate and study the impact and how to apply these practices before initiating the implementation of new practices. Furthermore, the organizations should communicate and collaborate with their employees or workers in order to increase the understanding of SResSCM concepts.

SRES had been applied in the organizations without understanding the meaning of "supply chain resilience management" from the relevant literature. The organizations had plans for dealing with unforeseen disruptions in different ways for different organizations, but they had the same aim, being "how to overcome disruptions with their supply chain members faster than competitors?" Moreover, the concept relating to existing literature on supply chain resilience had its aim as "the ability to prepare for unforeseen disruptions with the ability to respond and recover from them faster than competitors do" (Chopra and Sodhi, 2014; Christopher and Peck, 2004a; Jüttner and Maklan, 2011; Rice, 2011).

Therefore, organizations should develop plans from their past experience, and not only from the literature.

7.2.1.3 The understanding of performance measurement

The existing literature review in the field of SSCM and SRES found that there were some performance measurements in each concept. Neely et al. (1995) defined performance measurement as "the process of quantifying the efficiency and effectiveness of action" (p.80). Thus, this action can help organizations to improve their performance in the future. Phase One presented an understanding of performance measurement, applied performance in companies, and the barriers to measuring performance in companies where most of the organizations applied performance measurement in different sectors, such as transportation, production, warehousing or purchasing. Moreover, the organizations applied different performance measurement indicators, such as on-time delivery (OTD) for transportation, or energy usage (electrical, water, or gas) in production, or workers' health and welfare for social perspective, return of investment for economic perspective, and customer satisfaction for organizational progress. However, some participants mentioned that it was difficult to measure some aspects, as it took too long to do so. So it may be concluded that most organizations applied performance measurement to measure performance in different perspectives to improve their production processes or policies.

According to Phase Three interviews, the participants showed that their organizations had Key Performance Indicators (KPI) to measure their performance in SSCM and SRES. For example, one participant mentioned, "the organizations need to decrease or reduce for scrap rate as one of KPI in the production process". Moreover, Phase Three also confirmed that on-time delivery (OTD) was one important KPI for the organizations in Thailand, as KPI is a key goal for manufacturing in the electronic, electrical and automotive industries, which produced products 24/7. Thus, performance measurement in these industries related to delivery on time rather than other aspects, due to the need to reduce

inventory by improving the number of goods delivered. Furthermore, it can be seen that most of the organizations had signed contracts with their customers concerning fines for delays, so they assigned OTD as their standard KPI to reduce this cost. There were different measurements in different organizations, as they each needed to study and focus on the performance in their core business.

Furthermore, the results from Phase One to Phase Three also suggested that most performance measurement in the organizations came from their customers. So when the customers suggested certain activities or practices, the organizations needed to study these and apply them in their production to fulfil their requirements and maintain a long-term relationship with their customers. Therefore, performance measurement is not just assessing within the organization only, but should also be used to measure performance throughout the supply chains.

7.2.2. RQ2. What could be a suitable framework of sustainable *and* resilient supply chain management (SResSCM)?

The findings from this study suggest that organizations should understand the definitions of SSCM and SRES (or SResSCM) to improve supply chain performance and organizational performance and become more sustainable and resilient. Even so, as shown in chapter 5, H_1 was supported, while H_2 and H_3 were not supported, which confirms that SSCM had a positive relationship with SRES but the practices in organizations did not relate to the definition in the literature. Therefore the researcher trust that the definition of SResSCM provided in this study will help organizations in Thailand to develop their policy or processes to become more sustainable and resilient. This, in turn, should prove interesting for foreign investors to place their projects in Thailand.

RQ2 was used to review the relationship between SSCM and SRES in organizations. The researcher used interviews as an inductive process to explore and investigate the relationship between SSCM and SRES. First of all, the relationship was reviewed from the existing literature, and then SResSCM evolved from the relevant literature.

Phase One was used to review the practitioner's perspective. Most participants believed that SSCM and SRES were related; however, they could not give an exact definition of this relationship. It can be seen that some SSCM and SRES practices enhanced organizational performance and also supply chain performance. Moreover, the participants also argued that the relationship between SSCM and SRES depended on the nature of the product/process; so organizations needed to understand the nature of their product first. For instance, the electronic industry deals with fast-moving consumer goods (FMCG) in terms of technology, so organizations need to develop their products to serve global demand, which might be resilience, but is not sustainable.

The relationships were developed where the data from the practitioners' perspectives were collected by survey in Phase Two. Chapter 5 defined the relationship between sustainable supply chain management (SSCM_01) to supply chain resilience management (SRES_01) and amalgamated both concepts in a new definition as SResSCM (SSCM_02 and SRES_02). The findings showed that there was a relationship between SSCM and SRES from the practitioner's perspective (Table 5.2). Moreover, Table 5.9 showed the results from the EFA process, combining SSCM definition and SRES definition into one factor as sustainable and resilient supply chain management (SResSCM), and therefore confirming that these two concepts were related. In addition Table 5.21 shows factor loading for SResSCM definition with high range from 0.707-0.955. Thus, the survey results confirm that there is a relationship between SSCM and SRES from the practitioner's perspective.

During the Phase Three process, the researcher explained the results from previous phases to all participants and defined the relation between these two concepts in more detail. The results from Phase Three showed the participants had different thinking on SResSCM, between SSCM and SRES, which were (i) SSCM is a Major concept while SRES is a Minor concept, or (i) SRES is a Major concept and SSCM is a Minor concept, or (ii) SSCM and SRES support it together equally. Therefore, the researcher concluded that SSCM and SRES are related, but it depends on the experience and goals of each organization, which viewed these two concepts

together, i.e. SSCM supports SRES, and SRES supports SSCM to be better than stand-alone concepts.

Consequently, the purpose of Sustainable and Resilient Supply Chain Management (SResSCM) can be defined from the literature review (as stated in Section 2.8) as "*the management of materials, information and capital flows along the supply chains with three dimensions, being environmental, economic and social perspectives for the situation between before-during-after disruption periods by integrating vulnerability and capability factors to maintain continuity of operations at the desired level of connectedness and control over structure and function*". The definition of SResSCM was developed from Phase One and the results from Phase Two discussion. The researcher revised the SResSCM definition and it was then used to question to all participants in Phase Three (Appendix C, Section B, question 3). The researcher explained SResSCM to all participants as "*the management of materials, information and capital flows along the supply chain with three dimensions, being environmental, economic and social perspectives by integrating resilient practices to enhance supply chain performance for different periods of time to maintain continuity of operations at the desired level of production and customer satisfaction*".

Accordingly, having conducted Phase Three, the final definition of SResSCM was amended based on respondents' comments to ***"the management of total resources i.e. materials, information, capital flows, human resources, technology and marketing, by integrating sustainable and resilient practices to enhance supply chain performance at the desired level of production and to increase customer satisfaction by coordinating organizations between the entire supply chains"***.

This definition applied the existing definition from SSCM and SRES field and then it was developed during data collection of this thesis. This definition was developed from Thai's industry point of view; however, the researcher believes that this definition could be apply in all organizations in the world because the concept of

SResSCM in this thesis had been used in the real world already and then it was returned from practitioners' perspective to academia's perspective. Thus, the final definition of SResSCM will guide organizations to focus on practices, which can be enhancing performance to be more sustainable and resilient in organizations. Consequently, SResSCM framework from this step also leads to revise the House of SResSCM.

The house of SResSCM was amended and developed from Figure 2.24 with empirical findings from the quantitative analysis (Phase Two) and with EFA process (Figure 7.2). The main constructs of the SResSCM framework were revised from ECO-Design (ECO), green production (Green), social responsibility (SR), investment recovery (IR), collaboration (COL), external pressure (EXT), recovery (REC) and connectivity (CON) to internal and external plan (IEP), collaboration (COL), ECO-Design (ECO) and investment recovery (IR) as discussion in Section 5.3.4.4, and then it was validated and confirmed by participants in Phase Three, and will be explained in more detail below.

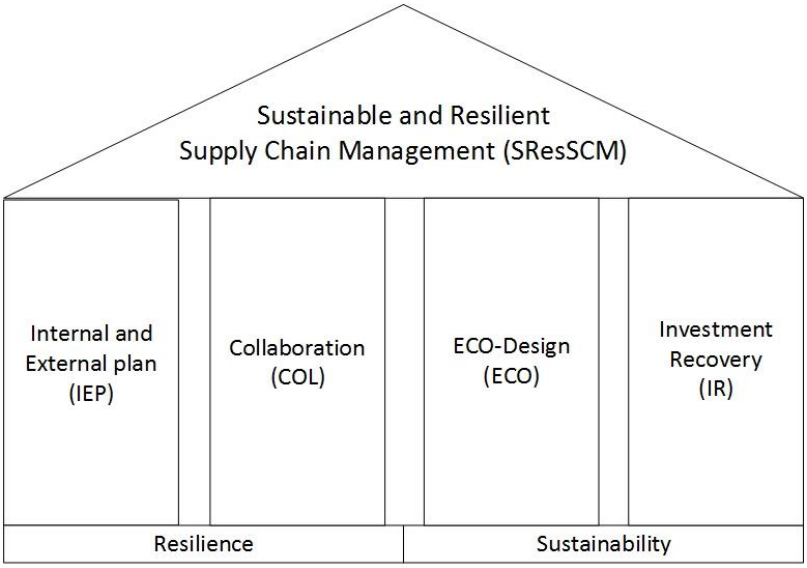

Figure 7.2: Empirical findings of SResSCM Framework

As shown in Figure 7.2, the house of SResSCM encompasses practices from SSCM, which are ECO and IR, and SRES practices, which are IEP and COL for this thesis.

These practices were studied and confirmed by Thai's practitioners that organizations should have all of these practices in their organizations. Moreover, the results from this study also showed that these practices support organizations to improve performance between SSCM and SRES at the same time. Therefore, organizations should focus on these practices and apply sub-level practices from this thesis with suit their organizations. The researcher trusts organizations, where have these practices, will gain more benefits from these practices if it was applied in the whole supply chains rather than individual organization. Thus, this thesis supports organizations by summarizing appropriate practices that organizations should use as a minimum standard for performance improvement in developing countries.

Furthermore, in Phase Three, the participants also confirmed that their understanding of SResSCM definition was not directly related to the implementation of SResSCM practices. However, organizations should provide the knowledge and promote more understanding of the SResSCM concept in their employees to gain more advantages from this idea. In addition, most participants in Phase Three confirmed that SResSCM concept could be applied by organizations and used in the real world. However, organizations should study and select appropriate SResSCM practices by employing the most relevant practices from this study to suit their organization. An interesting point that emerged from Phase Three was that employees were the main factor that could help organizations to achieve SResSCM goals, so they should therefore motivate their employees by being aware of their responsibility and role in implementing SResSCM concept.

7.2.3. RQ3. What would a valid measurement scale of SResSCM practices for performance improvement?

RQ3 studied the SResSCM practices implemented by organizations and the impact of SResSCM practices on SC performance and organizational performance. From the existing literature review, the researcher applied existing measurement scale, for instance, resilient practices from Pettit et al. (2013), SC performance from Govindan et al. (2015), SResSCM impact on organizational performance from

Govindan et al. (2014) and Li et al. (2006). This process enabled the researcher to verify a valid measurement scale for SResSCM practices as the new era for this area. Twenty-four questions on SResSCM practices were generated from Phase One and existing literature with a Five points-Likert's scale from Zhu et al. (2008) and Green et al. (2012), as: "scale 1 = not considering, scale 2 = planning to consider, scale 3 = considering it currently, scale 4 = initiating implementation and scale 5 = implementing successfully", with the option of "Do not know" for respondents who did not know about the SResSCM practices for each question, because even where SResSCM practices were applied in all production processes in an organization, the researcher believed that respondents might not be able to answer all questions.

Phase One demonstrated that all participants had some SResSCM practices in their organization, however, there were different levels of implementation: considering implementing, partial implementation and full implementation. Moreover, it can be seen that even if the organizations had a policy for these practices, their employees may not know about the definition of SSCM or SRES. This also confirmed the findings of previous stages, that while the definition of SResSCM was not important in an organization, SResSCM practices were important activities in enhancing supply chain performance and organizational performance. Section 4.6.1 also investigated eight SResSCM practices, which were developed from the existing literature for this study, and found that these practices could be associated with SResSCM concept. Moreover, Table 4.5 also suggested a possible measurement scale for SResSCM practices from Phase One results to collect data in Phase Two.

According to the survey results, two SSCM practices out of twelve (Table 5.3), had already been applied by organizations before the EFA process, i.e. "The company follows basic requirements of the Department of Labour for providing welfare and safety for employees (SR_02)" and "The company sells scrap and used materials to certified waste disposal companies (IR_01)". Moreover, there were two practices currently being considered by organizations, i.e. "The company design products that can be re-used and recycled (ECO_02)" and "The company has a programme to develop their employees or provides more academic than business (SR_03)". For

the remaining practices, the organizations were initiating implementation, i.e. ECO_01, ECO_03, GREEN_01, GREEN_02, GREEN_03, SR_01, IR_02, and IR_03. Moreover, it can be seen that after the EFA process, SSCM practices were reduced from twelve to seven, as mentioned in Table 5.11. On the other hand, SRES practices also had twelve examples for this study; however, after the EFA process, the SRES practices were reduced from twelve to nine, from which some practices were deleted as COL_01, CON_01 and CON_02.

Figure 7.3 presents variable relationships between this study, as Phase One, Two and Three. As discussed in Chapter 5, after the researcher conducted EFA process, the variables for SResSCM practices were changed. Twenty-four variables of SResSCM practices were tested across Phase Two; however only 16 variables were identified as important for SResSCM practices (eight variables being discarded from the analysis from Phase 2). SResSCM practices constructs were developed and the factor for each variable was changed. Therefore, these variables and constructs provide content validity from a Thai industry perspective.

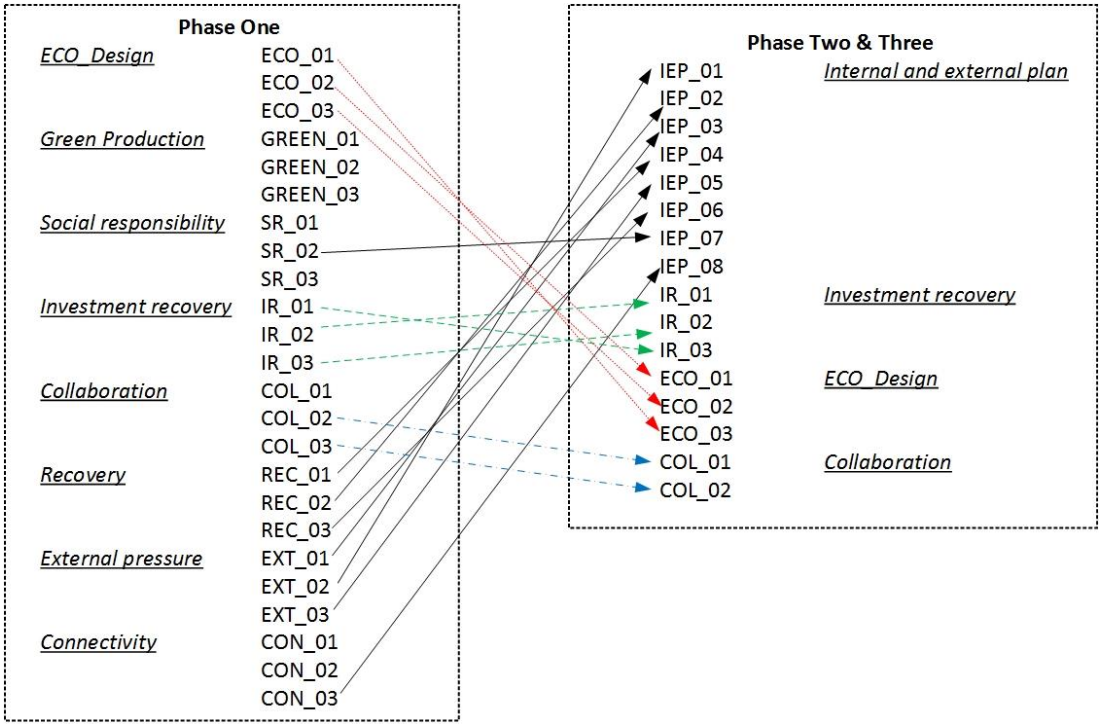

Figure 7.3: Resultant SResSCM variables and constructs from Phase Two

The comparison SResSCM variables and constructs from Phase Two and Phase Three including mean ranking, as mentioned in Chapter 5 and 6, are combined and re-stated in Table 7.1.

Table 7.1: Comparison SResSCM variables and constructs between Phase Two and Three

Construct	Variable Code	Phase Two (5 scale)		Phase Three (10 scale	
		Mean	Mean Rank	Mean	Mean Rank
Internal and External Plan (IEP)	IEP_01	4.61	**2**	9.786	**1**
	IEP_02	4.42	6	8.786	6
	IEP_03	4.50	**3**	8.846	**5**
	IEP_04	4.33	7	9.214	**3**
	IEP_05	4.46	**4**	9.071	**4**
	IEP_06	4.26	8	8.000	8
	IEP_07	4.62	**1**	9.571	**2**
	IEP_08	4.10	9	8.429	7
Investment Recovery (IR)	IR_01	4.02	10	8.000	8
	IR_02	4.46	**4**	7.750	13
	IR_03	3.68	13	7.929	10
ECO-design (ECO)	ECO_01	2.98	16	5.154	16
	ECO_02	3.79	12	7.923	11
	ECO_03	3.60	14	7.538	14
Collaboration (COL)	COL_01	3.15	15	5.357	15
	COL_02	3.88	11	7.857	12

Regarding Table 7.1, the comparison between Phase Two and Phase Three results with mean rank for SResSCM practices showed similar results between these two phases, as the participants thought that IEP practices were more important than other practices in the SResSCM concept. However, based on the existing literature for this study, it suggests that organizations should have all four practices but in the Thai context, they said there is only one practice, i.e. IEP. Hence, the researcher concludes that IEP is important practices and the other practices are less important. Therefore, this result supports the findings for this study that organizations implemented SRES practices more than SSCM practices. Nevertheless, all these practices were important for the SResSCM concept. Furthermore, stakeholder theory can be used to explain that internal and external groups will influence organizational practices, as all SResSCM practices are important. These practices

have impact on supply chain rather than individual organization. The next sub-section presents SResSCM practice results for each construct from this thesis.

7.2.3.1 Internal and external plan (IEP)

This practice links together the concept of SRES from Pettit et al. (2010). According to the survey results and EFA process from Phase Two, IEP factors combine practices from the literature into one construct: external pressure (EXT), recovery (REC), social responsibility (SR) and connectivity (CON). Internal and external plan was defined by this study as **"the ability of the organization to return to their normal process quickly after disruption periods with the reduction of external pressure to decrease business constraints and barriers by sharing their plan with suppliers and customers"**. Pettit et al. (2010) provided a supply chain resilience framework which combined vulnerabilities and capabilities to create resilience fitness space. They found that external pressure (i.e. IEP_01, IEP_03, and IEP_05) and connectivity (i.e. IEP_08) were the highest vulnerabilities faced, and recovery (i.e. IEP_02, IEP_04, and IEP_06) represented the capability strengths area in their study. In addition, Cruz and Wakolbinger (2008) highlighted that organizations needed to protect the environmental and health and safety regulations of workers, following basic requirements of the Department of Labour, such as social responsibility factor (i.e. IEP_07) from this construct. Therefore, IEP factor was developed as one pillar in Figure 7.2 for the resilience side of this study.

Moreover, when looking back to Phase One regarding external pressure (EXT_01 – EXT_03) and recovery practices (REC_01 – REC_03), the participants explained that organizations faced external pressure from Government to follow legislation and their competitors in developing their products and processes. Thus, they needed to apply activities based on Government policy for doing their business, and to improve their products continually compared to their competitors in the global market. Therefore, external pressure provided more business constraints and barriers for organizations (Pettit et al., 2010). Furthermore, regarding recovery practice, it can be seen that after the huge flooding in Thailand, most organizations

had prepared some plans or actions for more disruptions in the future. However, while recovery practice did not necessarily apply across an entire organization, it also applied to their suppliers, and plans were shared with customers as well. As Pettit et al. (2010) explained, recovery means the "ability to return to normal operational state rapidly" (p.12). Therefore this study confirms the findings of Pettit et al. (2010) that external pressure and connectivity are important for SRES in organizations.

These practices were used to review Phase Three, where it can be seen that IEP_01 – 08 were ranked 1 to 8 positions, as in Table 7.1, and where participants thought that these practices were most important for their organizations. Moreover, all IEP practices were applied successfully. Thus, IEP is an important factor in helping an organization to be more resilient, being one construct of SResSCM practice.

Furthermore, IEP is relevant with contingency theory because it deals with organizational management with external events. Internal and external integration will affect the practices in organizations and also relates to supply chain performance. Consequently, IEP from this thesis will support organizations and supply chains to prepare and overcome unforeseen disruptions in the future.

7.2.3.2 Investment Recovery (IR)

According to the existing literature, investment recovery has been studied by many researchers, such as Choi and Hwang (2015), Chan et al. (2010), Guide (2000), Spicer and Johnson (2004) and Zhu et al. (2008). For this study, IR variables were developed from the existing literature and Phase One, and verified by Phase Two. The participants in Phase One commented that this practice depended on the purchasing and accounting department to process this action. Moreover, most organizations in Phase One had been applying this practice in their production process, because they produced a lot of waste, and needed to dispose of it correctly. As mentioned by Choi and Hwang (2015), the computer and automobile industries were involved in implementing investment recovery for their products

and processes to maximize cost saving. Thus, most organizations in the electrical, electronic and automotive industries had already applied this practice in their policy.

Regarding EFA process, Phase Two concluded that these three variables were important factors for IR construct, but the EFA process had changed initial variables to revised variables to be more suitable in the relationship referred to in Table 5.13. Thus, IR_01 – IR_03 applied the definition of investment recovery from the literature to develop a measurement scale for SResSCM for this study.

The results from Phase Three showed that some organizations had been applying IR_01 and IR_03 in their production successfully, while, IR_02 was in the initial implementation process. All IR practices were important for the organizations from practitioners' perspectives as a second rank of SResSCM practices.

In conclusion, investment recovery for this study means **"the organizations have practices such as selling scrap and used materials to certified waste disposal companies to maximize cost saving and audit their waste disposal companies to ensure they process waste correctly according to BOI policy"**.

7.2.3.3 ECO-design (ECO)

One of the environmental practices from the existing literature review was ECO-design (Choi and Hwang, 2015; Govindan et al., 2013; Karlsson and Luttropp, 2006; Kleindorfer et al., 2005; Zhu et al., 2008). For this study, ECO-design was selected as one of the SResSCM practices. As explained in Phase One (see Section 4.6.1), ECO-design was applied by most organizations with different details. For instance, manufacturers in the electronic industry developed their products by reducing hazardous materials in production, reducing PVC tape in packaging processes, and reducing the size of packages for transportation. Moreover, it was found that ECO-design was not only applied within the manufacturing process, but also applied to suppliers as well. Therefore this practice needed to use

communication between suppliers and manufacturers in developing their products to be environmentally friendly, because 80% of environmental impact relates to early product design (Karlsson and Luttropp, 2006).

Three ECO-design variables were developed based on the existing literature and Phase One. According to the survey results from Phase Two, ECO-design was calculated by EFA process and it was found that these three variables had factor loading of more than 0.7 (range from 0.783-0.845); however, the researcher needed to change the sequence of variables (as Table 5.11). Furthermore, it can be seen that ECO-design had Cronbach's Alpha and Composite Reliability over threshold at 0.7 at 0.793 and 0.876, respectively. Thus, these results confirm that these variables of ECO-design showed reliability within this study.

Based on Phase Three, only ECO_03 was applied in organizations successfully. However, ECO_01 and ECO_02 were currently considering it, or initiating implementation processes, respectively. From the practitioners' perspectives, they thought that ECO_03 was a very important practice for organizations, but ECO_01 and ECO_02 were less important.

Therefore, ECO-design was a practice that organizations needed to apply in their products or processes, as mentioned by Eltayeb et al. (2011). Basic ECO-design activities incorporate five practices: 1) design for reduction or elimination of environmentally hazardous materials, 2) design for re-use, 3) design for recycling, 4) design for remanufacturing and 5) design for resource efficiency. Thus, the three variables of ECO-design construct could help organizations to evaluate their products to become more sustainable and resilient in the supply chains.

Moreover, based on practices in ECO-design, it can be seen that these sub-level practices (ECO_01 – ECO_03) have received affect from many parties (stakeholder), which are both internal and external to organizations. Thus, stakeholder theory influences organizations to implement this practice for Thai industry.

7.2.3.4 Collaboration (COL)

The last construct of SResSCM practices for this study was collaboration. There were two remaining variables for this construct, which were reduced from three. According to Pettit et al. (2010), collaboration is one of the capability factors to build resilience fitness space. Moreover, Pettit et al. (2013) found that low collaboration increased the concerns of corporate sponsors to enhance their resilience within the fitness space to best match the Zone of Balanced Resilience. Thus, collaboration was appropriate for SResSCM practices and SResSCM framework to enable supply chains to be more sustainable and resilient. Further, the existing literature explained collaboration as the ability to work with others, and share risk and information together (Christopher and Lee, 2004; Soni et al., 2011). Collaboration was a practice that the organizations applied or used as normal. Normally, the organizations contacted and communicated with their suppliers and customers when devising their production plan. Thus, collaboration was an important practice for suppliers-manufacturers-customers in improving supply chain performance.

According to Phase Two, the results showed that "COL_01, the company effectively employs collaborative demand forecasting techniques by using shared data (from Section B in the survey)" was removed from the EFA process. Thus the collaboration construct consisted of two variables, with the revised name of COL_01 and COL_02 in Table 5.11. The factor loadings of COL_01 and COL_02 from EFA were 0.895 and 0.677, respectively; with Cronbach's alpha and Composite Reliability are 0.671 and 0.856, respectively.

Moreover, Phase Three revealed that COL_02 was a very important practice for organizations and was being applied successfully. However, COL_01 was considered to be a less important practice, currently being considered. Most of the participants commented that this practice was not acceptable to their customers, while organizations needed to satisfy their customers as much as possible by avoiding any delays. Therefore, collaboration construct from these three phases was acceptable to use as a valid measurement scale of SResSCM.

7.2.3.5 A valid measurement scale of SResSCM

Accordingly, the previous steps from this study provided the evolution of a measurement scale of SResSCM practices by conducting inductive and deductive triangulation methodology to develop a valid scale from the academic perspective through to the practitioner's perspective. Thus, this result will examine implementation levels of SResSCM practice in the production processes and policies of organizations, and will guide the implementation of appropriate SResSCM, which could enhance supply chains to become more sustainable and resilient in the future. As is evident from this study, SResSCM practices could increase supply chain performance and organizational performance (explained further below). Consequently, four constructs of SResSCM practices were identified in this study: internal and external plan (IEP) – eight variables; investment recovery – three variables; ECO-design – three variables; and collaboration – two variables. The valid measurement scale of SResSCM is shown in Table 7.2.

Table 7.2: The implementation level measurement scale of SResSCM

Variable Code	Variable definitions	Measurement scale				
		Not considering	Planning to consider	Considering it currently	Initiating implementation	Implementing successfully
Internal and External Plan (IEP)						
IEP _01	The company implements basic requirements that customers request	1	2	3	4	5
IEP _02	The company takes immediate action to mitigate the effects of disruptions, despite the short-term costs	1	2	3	4	5
IEP _03	The company follows Government/BOI legislation to conduct business using tax, or import-export criteria	1	2	3	4	5
IEP _04	The company can quickly provide a formal response team of key personnel, both on-site and at corporate level	1	2	3	4	5
IEP _05	The company uses customer feedback to develop their products/productions	1	2	3	4	5
IEP _06	The company has a contingency plan for unforeseen disruptions	1	2	3	4	5
IEP _07	The company follows basic requirements of the Department of Labour for providing welfare and safety for employees	1	2	3	4	5
IEP _08	The company's suppliers receive information about customer requirements to support the production in the company	1	2	3	4	5
Investment Recovery (IR)						
IR_01	The company audits their waste disposal companies to ensure it processes waste correctly	1	2	3	4	5
IR_02	The company uses the policy of Board of Investment (BOI), Thailand as procedures for waste disposal	1	2	3	4	5
IR_03	The company sells scrap and used materials to certified waste disposal companies	1	2	3	4	5
ECO-design (ECO)						
ECO_01	The company designs products that can be re-used and recycled	1	2	3	4	5
ECO_02	The company designs products that focus on the reduction of resource consumption and waste generation in product usage	1	2	3	4	5
ECO_03	The company adopted environmental concerns when designing their products/processes	1	2	3	4	5
Collaboration (COL)						
COL_01	The company's customers are willing to delay orders when the company's production capacity is hampered	1	2	3	4	5
COL_02	The company communicates important information to their suppliers and customers for unforeseen disruptions	1	2	3	4	5

The implementation level measurement scale of SResSCM practices as presented in Table 7.2 represented the checklists for organizations. This table uses to assess the current level in each SResSCM practice in organization. The results after used this table will show that organization implemented in which practices already. On the other hand, which practices were not yet implemented. Then, organizations might study and prepare to implement appropriate practices that suit for their organization based on this thesis. Organizations would focus on the practices, which are not considering, planning to consider or considering it currently from their results because these practices will support organizations in the future. However, the researcher still suggests that organizations should review and remain practices in initiating implementation and implementing successfully level to ensure that these practices still valid and active in organization's practices. Moreover, based on Table 7.1, the findings from Thai manufacturing highlights that organizations may focus on IEP practices first, and then on IR, ECO and COL, respectively.

These SResSCM practices were validated and confirmed by practitioners in this thesis such that these practices can be used in organizations to improve performance to be more sustainable and resilient in future. Hence, the researcher suggests that organizations could implement these practices. Consequently, the researcher believes that this table will support policy's maker or top management in organizations around the world to focus on these practices and assess their current level to decide which part of SResSCM in their organization need to be improved. Table 7.2 shows the valid measurement scale of SResSCM practices for performance improvement for this thesis.

7.2.4. RQ4: What is the impact of SResSCM practices on supply chain performance and organizational performance?

The last research question of this study is related to SResSCM practices on supply chain performance and organizational performance. In this study, it was found that SResSCM practices influence improvement in supply chain performance; however, SResSCM also has an impact on organizational performance. The study separated

the influence of SResSCM practices on organizational performance into different periods of time: i) short-term (0 – 3 years) and ii) long-term (more than 3 years). According to the evidence from Phase Two, SResSCM practices will improve SC performance, the relationship between SResSCM practices and SC performance being significant. Moreover, it was found that SResSCM practices have a positive effect on SC performance, with both short-term impact and long-term impact. This section will examine more evidence from Phase One to Phase Three of the study.

As presented in Table 5.26, SResSCM practices have a significance level of 1% on supply chain performance (*t* value = 4.162, *p* – value = 0.000) and a significance level of 1% on SResSCM impact (*t*-value = 2.947 and *p*-value = 0.005). So it can be concluded that SResSCM practices had a significant effect on supply chain performance in this study, with both short-term impact and long-term impact. There were four latent variables for SC performance and four variables for SResSCM impact. The results from Phase One to Phase Three also demonstrated a strong relationship between SResSCM practices, SC performance and SResSCM impact, and that organizations will see SC performance improvement after implementing these SResSCM practices. However, there is no guarantee. Consequently, the following section will explain in more detail the impact of supply chain performance and SResSCM derived from this study.

7.2.4.1 Supply chain performance

Supply chain performance measures in this study were applied according to the study of Azevedo et al. (2013a), these measures being operational cost (OPT) (Jeffery et al., 2008), business wastage (BUS) (Singh et al., 2010), environmental cost (ENV) (Christiansen et al., 2003; Tsai and Hung, 2009; Zhu et al., 2005) and customer satisfaction (CS) (Beamon, 1999). Moreover, the questionnaires, which were used in the survey, were developed from the existing literature (Govindan et al., 2015; Green et al., 2012) and Phase One results (Section 4.7 and 4.8). Therefore, there were six variables in OPT and BUS, five variables in ENV and seven variables in CS (with 24 variables for supply chain performance construct). As stated

in Section 3.5.7, all data were entered and analysed with SPSS for descriptive analysis and exploratory factor analysis (EFA), and smartPLS 3.0 for PLS-SEM. After running the EFA process, the results (Section 5.3.4.5) showed nine variables, as three variables from OPT, three variables from BUS, two variables from ENV, and one variable from CS, which was removed during this process, being lower than the cut-off (loading cu- off for this study is 0.55, as explained in Table 5.13).

Therefore, the remaining variables were grouped with relevant factors, as presented in Table 5.17 and SC performance variables were renamed, combining customer satisfaction and operational cost variables in one factor, as customer and operational cost (COC), and remaining variables named as environmental cost (ENV), business wastage (BUS) and customer satisfaction (CS). Furthermore, the results from Phase Three showed the ranking for SC performance constructs from practitioners' perspectives from 1 (the most important) to 4 (least important) as (1) CS, (2) COC, (3) BUS and (4) ENV, as most participants thought that customer satisfaction was a key factor that organizations needed to improve or develop once they had applied SResSCM. However, when comparing the mean from Phase Two and Phase Three, it can be seen that CS variables had a lower rank than other SC performance variables, i.e. CS_01 ranked 15 in Phase Two and ranked 11 in Phase Three; CS_02 ranked 11 in Phase Two and ranked 12 in Phase Three. Nevertheless, the results from this study confirmed that these variables were important for organizations from the practitioner's perspective.

The following section will describe first-order constructs from PLS-SEM with smartPLS3.0. For this study, hierarchical latent variables models were employed; in consequence, supply chain performance was a second-order construct, and COC, ENV, BUS and CS first-order constructs with reflective-reflective type models.

7.2.4.1.1 Customer and operational cost (COC)

Considering "customer and operational cost" (COC), this was a first-order construct, with six variables, which combined with three operational cost variables (in

COC_02, COC_03 and COC_05) and three customer satisfaction variables (in COC_01, COC_04 and COC_06) in Table 7.3. It had factor loading from 0.560 – 0.780. For structural model between supply chain performance and latent variables of COC, it showed a 1% significance level at *t*-value = 7.009 and *p*-value = 0.000 (see Table 5.27). Table 7.3 presented the data for COC constructs, all outer loading of COC being well above the threshold value of 0.7, which suggests sufficient levels of indicator reliability. The indicator COC_03 had the smallest indicator reliability with a value of 0.549 (0.741^2), while the indicators COC_01 and COC_04 had the highest indicator reliability, with a value of 0.687 (0.829^2). Moreover, all variables of COC had a 1% significant level. The survey results hence confirmed that SResSCM practices provided supply chain performance in terms of customer and operational costs for all variables.

Table 7.3 also shows the relevant existing literature for each variable. For instance, COC_01 was related to improved capacity utilization, Zhu et al. (2008) applying this item for operational performance; however, for this study it was allocated to customer and operational cost construct. Moreover, COC_02 and COC_3 were used for economic performance by Green et al. (2012) and Zhu et al. (2008), but were suitable COC constructs for this study. In addition, COC_04 and COC_06 were related to Govindan et al. (2015) study, as they found lean, green and resilient practices influence on supply chain performance, so these variables confirm that SResSCM practices influenced supply chain performance in COC construct as well.

Table 7.3: Customer and operational cost construct

Variable	Variable definitions	Outer Loading	Phase Two (5 scale)		Phase Three (10 scale)		SResSCM → SC performance	Sources
			Mean	Mean Rank	Mean	Mean Rank		
COC_01	The company improved capacity utilisation	0.829	4.30	1	8.429	8	Agree	Green et al. (2012) Zhu et al. (2008)
COC_02	The company can decrease expenses on energy consumption	0.753	4.29	2	7.643	13	Agree	Green et al. (2012) Zhu et al. (2008)
COC_03	The company can decrease expenses of materials purchasing	0.741	4.21	4	9.214	2	Strongly Agree	Green et al. (2012) Zhu et al. (2008)
COC_04	The company increased the amount of goods delivered on time	0.829	4.25	3	9.429	1	Strongly Agree	Govindan et al. (2015) and 1st interview
COC_05	The company can decrease inventory levels in their warehouse	0.771	4.15	7	9.071	4	Strongly Agree	Green et al. (2012) Zhu et al. (2008)
COC_06	The company improved an effective strategy for communications in a variety of extraordinary situations	0.761	4.12	9	8.500	7	Strongly Agree	Govindan et al. (2015) and 1st interview

As mentioned in Table 6.4 and re-stated in Table 7.3, the results also suggested that SResSCM in the organizations helped to improve SC performance from the practitioner's perspective, with "strongly agree" in COC_03, COC_04, COC_05 and COC_06, while COC_01 and COC_02 were supported by SResSCM practices with the "agree" option from participants. Moreover, the mean rank comparison between Phase Two and Phase Three suggested that Phase Two considered COC_01 to be the most important for organizations, while Phase Three considered COC_04 to be the most important. Furthermore, it can be seen that COC_02 had a higher rank in Phase Two but a lower rank in Phase Three. The reason for this might be that participants in Phase Three believed that SResSCM would increase costs at the start of the implementation period, but they would decrease in the long term, so they rated COC_02 as less important. Notwithstanding, COC variables were the most important in SC performance from the practitioner's perspective.

7.2.4.1.2 Environmental cost (ENV)

Regarding environmental cost, it was crucial to have information about environmental practice costs to scrap/re-work (Christiansen et al., 2003), on waste disposal costs (Tsai and Hung, 2009), on purchasing environmentally friendly materials (Zhu et al., 2005), and certification, among others. For this study, environmental cost construct comprises of four variables after the EFA process, as demonstrated in Table 5.17. The variables related results agree with the studies of Green et al. (2012) and Zhu et al. (2008). ENV had factor loading from 0.691 – 0.823 (Table 5.15). Moreover, in Table 5.27, ENV had a 1% significant level on SC performance (t-value = 7.533 and p-value = 0.000). Table 7.4 stated the outer loading for ENV construct, ranged from 0.787 to 0.943. ENV_04 had the smallest reliability with the value 0.619 (0.787^2). By contrast, ENV_02 had the highest reliability at value 0.889 (0.943^2). Furthermore, all variables also had significance at 1% level, therefore, it can be confirmed that SResSCM influences SC performance in terms of environmental cost.

In the existing literature, ENV_01 was used for economic performance, ENV_02 and ENV 04 were used for environmental performance, and ENV_03 was used for operational performance (Green et al., 2012; Zhu et al., 2008). However, for this study, these variables were used for environmental cost construct. The respondents indicated that SResSCM helped the organizations to reduce expenses on waste discharge, effluent waste, environmental accidents, and increase production lines.

Table 7.4: Environmental cost construct

Variable	Variable definitions	Outer Loading	Phase Two (5 scale)		Phase Three (10 scale)		SResSCM → SC performance	Sources
			Mean	Mean Rank	Mean	Mean Rank		
ENV_01	The company can decrease expenses for waste discharge	0.918	3.96	12	8.357	9	Strongly Agree	Green et al. (2012) Zhu et al. (2008)
ENV_02	The company can decrease effluent waste	0.943	3.98	11	7.571	14	Agree	Green et al. (2012) Zhu et al. (2008)
ENV_03	The company has increased production lines	0.803	3.89	13	8.643	6	Strongly Agree	Green et al. (2012) Zhu et al. (2008)
ENV_04	The company can decrease expenses for environmental accidents	0.787	4.06	10	8.286	10	Strongly Agree	Green et al. (2012) Zhu et al. (2008)

According to Table 6.4 in Phase Three and Table 7.4 above, the practitioners strongly agreed that ENV_01, ENV_03 and ENV_04 would be improved by implementing SResSCM practices in the organization. While the practitioners believed that ENV_02 was lower in importance than other aspects, they still agreed that SResSCM practices helped to improve SC performance in their organizations. Moreover, Table 7.4 also presented mean and ranking from the practitioner's perspective in relation to ENV variables for Phase Two and Phase Three. The findings indicate that practitioners did not have different opinions on ENV variables, as they thought all ENV variables had a medium to low important for organizations. However, ENV_03 got more attention from Phase Three than Phase Two, as mean ranking increased from rank 13 to rank 6, because practitioners believed that if organizations could be more sustainable and resilient, it would help them to increase production lines. On the other hand, ENV_02 had less importance in Phase Three than Phase Two because participants in Phase Three used less water in their production, so they might not have needed to do waste-water treatment before discharge; while some participants mentioned that they needed to do waste-water treatment before discharge because the factory was close to the river. This

performance aspect might therefore have different importance for each participant.

7.2.4.1.3 Business wastage (BUS)

Business wastage was explained as "used in its broader sense including typical lean wastages, i.e. effects in products, excessive inventory, excessive lead-time, excessive scarp, excessive transportation (p.49) (Singh et al., 2010) and also solid and liquid wastes, percentage of materials remanufactured, recycled and re-used, hazardous and toxic material output (p.19) (Govindan et al., 2015)". For this study, business wastage had three variables after the EFA process, as presented in Table 7.5. This construct presents an organization's ability to decrease consumption of hazardous/harmful/toxic materials and scrap rate, and increase production quality. Consequently, it should be mentioned that SResSCM can help an organization to reduce business wastage and improve supply chain performance at the same time.

BUS had factor loading between 0.672 – 0.784 (see Table 5.15) and latent variables of BUS had a 1% significant level on SC performance (*t*-value = 7.232 and *p*-value = 0.000 as Table 5.27). BUS_03, "the company can decrease scrap rate", had the highest reliability at value 0.815 (0.903^2). Green et al. (2012) allocated BUS_02 and BUS_03 as operational performance and BUS_01 as environmental performance; however, these variables were combined together in this study. It was suitable to use business wastage with these variables because it related to the definition of business wastage in the literature (Green et al., 2012; Singh et al., 2010).

Table 7.5: Business wastage construct

Variable	Variable definitions	Outer Loading	Phase Two (5 scale)		Phase Three (10 scale)		SResSCM → SC performance	Sources
			Mean	Mean Rank	Mean	Mean Rank		
BUS_01	The company can decrease consumption of hazardous materials	0.874	4.17	6	7.500	15	Strongly Agree	Green et al. (2012) Zhu et al. (2008)
BUS_02	The company increased product quality	0.802	4.21	4	9.143	3	Strongly Agree	Green et al. (2012) Zhu et al. (2008)
BUS_03	The company can decrease scrap rate	0.903	4.15	7	8.929	5	Strongly Agree	Green et al. (2012) Zhu et al. (2008)

Regarding the results from Phase Three, all variables in BUS construct helped the organization to improve SC performance from the practitioner's perspective, with "strongly agree". However, Phase Three suggested that BUS_01 had a lower importance than the other variables (with rank 15), while Phase Two suggested that BUS_01 was quite important (with rank 6), because practitioners explained that organizations needed to follow Government legislation about reducing hazardous or dangerous materials in production lines, so this performance had been enforced by Government already. On the other hand, BUS_02 and BUS_03 received more importance from Phase Three than Phase Two, i.e. increased from rank 4 to rank 3 for BUS_02, and rank 7 to rank 5 for BUS_03. The reason was that practitioners trusted that SResSCM would help organizations to improve performance in production lines, increasing product quality, and reducing the production of waste or scrap.

7.2.4.1.4 Customer satisfaction (CS)

Customer satisfaction is "the degree to which customers are satisfied with the product and/or service received along the supply chain" (p.278) (Beamon, 1999). A satisfied customer will repeat the purchases of goods or services; therefore, it is a measure of an organization's competitiveness (Govindan et al., 2015). For this study, CS had two variables (after EFA process), related to the number of supply chain members and amount of outsourcing. The survey results showed that CS had a 1% significant level on SC performance (Table 5.27) (*t*-value = 5.076 and *p*-value = 0.000). Moreover, the factor loading of CS_01 and CS_02 was 0.837 and 0.834, respectively. It can be concluded that SResSCM influenced the organizations to increase the number of supply chain members, and also to conduct outsourcing for support during unforeseen disruptions, and to improve supply chain performance.

Table 7.6: Customer satisfaction construct

Variable	Variable definitions	Outer Loading	Phase Two (5 scale)		Phase Three (10 scale)		SResSCM → SC performance	Sources
			Mean	Mean Rank	Mean	Mean Rank		
CS_01	The company increased the outsourcing of materials by various suppliers	0.93	3.83	15	8.071	11	Agree	Govindan et al. (2015) and 1st interview
CS_02	The company increased a large number of members in supply chains	0.9	3.85	14	8.000	12	Agree	Govindan et al. (2015) and 1st interview

Although CS was selected with the number one ranking on SC performance construct from Phase Three, CS_01 and CS_02 had a low ranking on SC performance for this study. Phase Three agreed that SResSCM practices helped to improve SC performance, ranking 11 and 12, respectively, while Phase Two considered CS_01 and CS_02 to have less importance than other variables, ranking 15 and 14, respectively. Even though these rankings were lowest for SC performance variables, but they were still important for organizations from the practitioner's perspective.

This sub-section showed the results from three phases of research methodology for supply chain performance. The variables were reduced from 24 (Phase One) to 15 variables (Phase Two), and the results were confirmed in Phase Three in relation to SResSCM as the main purpose of this research. It can be seen that supply chain performance from this study relates to the existing literature, so practitioners could be confident that these results had high reliability and validity. The next sub-section presents SResSCM impact over different periods of time, both short and long-term, on SResSCM practices and organizational performance.

7.2.4.2 SResSCM impact

For the research objectives of this study, the different periods of time for implementation of SResSCM practices in organizations were assessed. They were divided into two main time periods, as short and long-term impact, accounting from the time that the organization started to implement these practices, the impact being defined in terms of SResSCM practices impact and organizational performance. Green and Inman (2005) defined organizational performance as "financial and marketing performance of the organization as compared to the industry average" (p.3445). The existing literature demonstrated some practices that impact on organizational performance. For instance, GSCM practices led to improved organizational performance (Green et al., 2012). Moreover, Li et al. (2006) indicated that higher levels of SCM practice can lead to both improved competitive advantage and improved organizational performance. In addition, Tan

et al. (1998b) described the short-term objectives of SCM as being primarily to increase productivity and reduce inventory and cycle time, while long-term objectives were to increase market share and profits for all members of the supply chain. Some studies have measured organizational performance by using both financial and marketing criteria, including return on investment (ROI), market share, profit margin on sales, the growth of ROI, the growth of sales, the growth of market shares and overall competitive position (Green and Inman, 2005; Green et al., 2012; Li et al., 2006). Thus, the same items were applied to measure organizational performance in this study.

According to Phase One, the researcher found that there were some aspects of SSCM and SRES which impact within and outside organizations. The practitioners mentioned that once organizations have implemented SSCM into their policy, it has a direct impact on their suppliers to develop their processes, relying on the organizations' criteria. Moreover, customers also had an impact on the organizations, because they required them to be more sustainable in their products. There was also an impact on the procedures and processes of organizations. For instance, the employees needed to learn new things about SSCM or SRES policy, which involved more processes than previously, because SSCM and SRES practices directly impact on employees in the supply chain. Furthermore, the practitioners thought that there was some cost in implementing SSCM and SRES within organizations, but it was appropriate to invest because the cost would decrease, and these practices would result in greater competitive advantage for organizations in the long-term period. Moreover, the practitioners also believed that SRES policy, such as preparing plans for unforeseen disruptions would help organizations to survive and return to normal faster than their competitors. However, SRES needed to also be applied within the supply chain, and not just within the organization. Thus, SRES could help improve business for the entire supply chain.

The results from Phase One were adapted in Phase Two for the development of measurement tools to gauge SResSCM impact. Hierarchical latent variables models

were employed for the SResSCM impact construct as well. It was clear that SResSCM impact was a second-order construct with a first-order construct, as mentioned in Chapter 5. Four first-order constructs derived from this study, which were changed between Phase One and Phase Two (after running EFA process), as (i) SResSCM practices impact (SRESPI), (ii) long-term organizational performance (LOP), (iii) short-term financial (STF), and (iv) short-term growth (STG). As presented in Section 5.3.7, the results from PLS-SEM with EFA process showed that SResSCM practices had a 1% significant level on SResSCM impact (*t*-value = 2.947, *p*-value = 0.005, Table 5.26).

As shown in Figure 6.2, which presents the ranking of SResSCM impact from the practitioner's perspective from Phase Three, it was found that the most important SResSCM impact construct for organizations was SRESPI, because when organizations implement new strategy, practices or policy, it will directly impact current practices and procedures. Following this, the next most important constructs were STF and STG, having equal level from the practitioner's perspective. The last construct was LOP. Thus, the results from Phase Two and Phase Three also confirmed that practitioners emphasized short-term impact rather than long-term impact. Therefore, once organizations have implemented SResSCM practices in their production, it can be foreseen that they will pay attention to the development of practices, focusing on short-term impact rather than long-term impact, respectively.

The following section will explain these first-order constructs from PLS-SEM with smartPLS3.0. For this study, hierarchical latent variables models were employed; in consequence, SResSCM impact was a second-order construct and SRESPI, LOP, STF and STG first-order constructs with reflective-reflective type models.

7.2.4.2.1 SResSCM practices impact (SRESPI)

Considering the "SResSCM practices impact" (SRESPI) construct, there were 16 variables in this construct. It appeared that SRESPI construct included eight

variables for short-term practices and eight variables for long-term practices. As found in Table 5.27, each SResSCM practice was divided into two periods, short and long-term impact. Latent SRESPI variables had a 1% significant level (t-value = 2.612, p-value = 0.014) on SResSCM impact. For this construct, SResSCM practices were applied from the existing literature (Cruz and Wakolbinger, 2008; Govindan et al., 2013; Green et al., 2012; Kjaerheim, 2005; Pettit et al., 2010; Pettit et al., 2013; Sarkis et al., 2010; Zhu et al., 2008), and examined over the different periods of time. It showed that outer loading for all variables ranged from 0.761 – 0.925, in which SRESPI_01 had the highest reliability, with a value of 0.856 (0.925^2), while SRESPI_16 had the smallest reliability with a value 0.579 (0.761^2). Moreover, when comparing short-term impact and long-term impact for each SResSCM practice, it can be seen that long-term practices impact had higher loading than short-term practices impact.

Describing ECO-design, Green et al. (2012) mentioned that "capability to reduce environmental pollutants is counterbalanced by increase in associated costs perhaps related to materials purchases" (p.298). Thus, the survey results also confirmed that ECO-design had an impact in both the short-term and log-term. This result was similar to Zhu et al. (2008), who found that ECO-design was positively linked to GSCM practices in Chinese manufacturers. For this study, it can be seen that ECO-design was positively linked to SResSCM practices and SResSCM impact in both short-term (SRESPI_16) and long-term (SRESPI_08) impact on organizations.

Even though Table 7.7 shows that SRESPI variables had lower mean rank than other SResSCM impacts. Nevertheless, this study maintains that SRESPI still had greatest importance for organizations, as confirmed by the Phase Three results.

Table 7.7: SResSCM practices impact construct

Variable	Variable definitions	Outer Loading	Phase Two (5 scale)		Sources
			Mean	Mean Rank	
SRESPI_01	Long-term impact Green production	0.925	3.02	16	Kjaerheim (2005) Zhu et al. (2008)
SRESPI_02	Long-term impact Collaboration	0.914	2.90	25	Pettit et al. (2010) Pettit et al. (2013) Zhu et al. (2008)
SRESPI_03	Short-term impact Connectivity	0.884	2.91	24	Pettit et al. (2010) Pettit et al. (2013)
SRESPI_04	Long-term impact Connectivity	0.899	3.02	16	Pettit et al. (2010) Pettit et al. (2013)
SRESPI_05	Long-term impact Social responsibility	0.915	3.03	13	Cruz and Wakolbinger (2008) Govindan et al. (2013) Sarkis et al. (2010)
SRESPI_06	Long-term impact Recovery	0.904	2.98	20	Pettit et al. (2010) Pettit et al. (2013)
SRESPI_07	Long-term impact Investment recovery	0.906	3.06	10	Green et al. (2012) Zhu et al. (2008)
SRESPI_08	Long-term impact Eco-design	0.897	3.03	13	Green et al. (2012) Zhu et al. (2008)
SRESPI_09	Short-term impact Collaboration	0.888	2.81	29	Pettit et al. (2010) Pettit et al. (2013) Zhu et al. (2008)
SRESPI_10	Long-term impact External pressure	0.859	2.99	19	Pettit et al. (2010) Pettit et al. (2013)
SRESPI_11	Short-term impact Investment recovery	0.875	2.86	26	Green et al. (2012) Zhu et al. (2008)
SRESPI_12	Short-term impact Green production	0.903	2.81	29	Kjaerheim (2005) Zhu et al. (2008)
SRESPI_13	Short-term impact Recovery	0.841	2.86	26	Pettit et al. (2010) Pettit et al. (2013)
SRESPI_14	Short-term impact External pressure	0.792	2.85	28	Pettit et al. (2010) Pettit et al. (2013)
SRESPI_15	Short-term impact Social responsibility	0.813	2.80	31	Cruz and Wakolbinger (2008) Govindan et al. (2013) Sarkis et al. (2010)
SRESPI_16	Short-term impact Eco-design	0.761	2.71	32	Green et al. (2012) Zhu et al. (2008)

7.2.4.2.2 Long-term organizational performance (LOP)

For long-term organizational performance (LOP), this construct had eight variables, which encompassed profit growth (LOP_01), average market share growth (LOP_02), average sales volume growth (LOP_03), average profit (LOP_04), average return on sales (LOP_05), average return on investment (LOP_06), average sales (in Thai Baht) growth (LOP_07) and average overall competitive position (LOP_08). These variables had outer loading from 0.735 – 0.927. Table 7.8 shows that LOP had a higher mean than other constructs for SResSCM impact in Phase Two, but low impact from the practitioner's perspective in Phase Three. The reason might be that respondents may not have understood the concept of long-term or they may have

been thinking of results in the short-term, so when they did the survey, they may have thought that long-term was more important; however, it was not statistically significant. It can be concluded that long-term performance was more important for survey respondents and more statistically robust in Phase Three.

Table 7.8: Long-term organizational performance construct

Variable	Variable definitions	Outer Loading	Phase Two (5 scale)		Sources
			Mean	Mean Rank	
LOP_01	Long-term Profit growth	0.885	3.23	8	Green and Inman (2005) Green et al. (2012)
LOP_02	Long-term Average market share growth	0.876	3.30	3	Green and Inman (2005) Green et al. (2012) Li et al. (2006)
LOP_03	Long-term Average sales volume growth	0.927	3.30	3	Green and Inman (2005) Green et al. (2012) Li et al. (2006)
LOP_04	Long-term Average profit	0.898	3.27	6	Green and Inman (2005) Green et al. (2012)
LOP_05	Long-term Average return on sales	0.877	3.27	6	Green and Inman (2005) Green et al. (2012)
LOP_06	Long-term Average return on investment	0.855	3.29	5	Green and Inman (2005) Green et al. (2012) Li et al. (2006)
LOP_07	Long-term Average sales (in Thai Baht) growth	0.924	3.33	2	Green and Inman (2005) Green et al. (2012)
LOP_08	Long-term Average overall competitive position	0.735	3.41	1	Green and Inman (2005) Green et al. (2012) Li et al. (2006)

7.2.4.2.3 Short-term financial construct (STF)

Short-term financial (STF) construct had four variables, which were short-term impact on average profit (STF_01), average return on investment (STF_02), profit growth (STF_03), and average return on sales (STF_04). Table 7.9 presents the mean rank for STF with position of lower rank than LOP, but it became more interesting with higher rank in Phase Three.

Table 7.9: Short-term financial construct

Variable	Variable definitions	Outer Loading	Phase Two (5 scale)		Sources
			Mean	Mean Rank	
STF_01	Short-term Average profit	0.91	2.95	22	Green and Inman (2005) Green et al. (2012)
STF_02	Short-term Average return on investment	0.882	3.05	21	Green and Inman (2005) Green et al. (2012) Li et al. (2006)
STF_03	Short-term Profit growth	0.928	3.00	18	Green and Inman (2005) Green et al. (2012)
STF_04	Short-term Average return on sales	0.866	2.95	22	Green and Inman (2005) Green et al. (2012)

7.2.4.2.4 Short-term growth (STG)

Short-term growth (STG) had four variables, which were short-term impact on average sales (in Thai Baht) growth (STG_01), average sales volume growth (STG_02), average market share growth (STG_03) and average overall competitive position (STG_04). The mean ranks, presented in Table 7.10, also confirmed that STG had a medium impact from SResSCM practices from the practitioner's perspective from Phase Two and Phase Three.

Table 7.10: Short-term growth construct

Variable	Variable definitions	Outer Loading	Phase Two (5 scale)		Sources
			Mean	Mean Rank	
STG_01	Short-term Average sales (in Thai Baht) growth	0.954	3.05	11	Green and Inman (2005) Green et al. (2012)
STG_02	Short-term Average sales volume growth	0.907	3.03	13	Green and Inman (2005) Green et al. (2012) Li et al. (2006)
STG_03	Short-term Average market share growth	0.906	3.04	12	Green and Inman (2005) Green et al. (2012) Li et al. (2006)
STG_04	Short-term Average overall competitive position	0.791	3.14	9	Green and Inman (2005) Green et al. (2012) Li et al. (2006)

In summary, the benefits of adopting SResSCM definition and practices in manufacturing have been explained during this thesis; however, some managers remain unconvinced in adopting SResSCM concept. Thus, this study determines the potential positive effects of SResSCM concept on SC performance and organizational performance. As mentioned in Section 7.2.4 above, Figure 7.4

summarizes the results from Phase One to Phase Three for the relationship between SResSCM practices, SC performance and SResSCM impact.

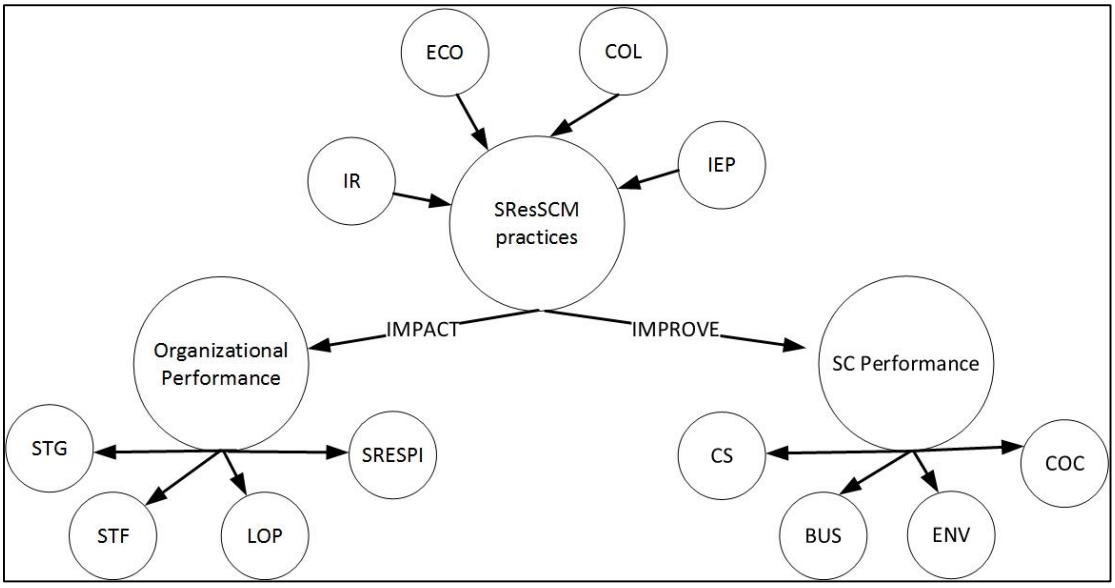

Figure 7.4: Summary relationship for RQ4

7.3 Integrating empirical findings with the literature

This section summarizes the findings from the researchers' empirical findings with the existing body of knowledge in the SSCM and SRES field and from SLR process in Chapter 2. This section links the research findings from Phase One to Phase Three with relevant themes from the literature review. The empirical evidence suggested that there is a wide spread of SSCM and SRES concepts in Thai manufacturing; however, these concepts were not fully understood. Moreover, the general impression from this thesis showed that the understanding of SRES was less than the understanding of SSCM in the Thai context. To achieve robust sustainable and resilient supply chain management in Thai manufacturing, knowledge sharing is a key factor in improving the understanding from academics to practitioners. Consequently, this thesis has provided some insights adding to the existing literature related to SSCM and SRES, as follows below.

The empirical evidence suggests that SSCM and SRES function had an impact right down the supply chain, i.e. suppliers, manufacturers and customers or

stakeholders. This supports the views of Darnall et al. (2008) that SCM function had an impact along the supply chain. The findings also support the view of Carter and Rogers (2008) and Sarkis et al. (2011), that organizations could improve long-term economic growth after implementing environmental and social practices. Furthermore, the findings also confirmed that large organizations, the Thai Government, and international companies should support smaller organizations in becoming more sustainable and resilient. This relates to Yusuf et al. (2013), who maintained that smaller organizations needed financial and technical support. The author's work fully supports the views of Govindan et al. (2013) and Zhu et al. (2008) that organizations have already been applying ECO-design for their products and processes. However, for this study, the organizations applied ECO-design to reduce consumption or waste, but could not apply it for re-use or recycling, because the waste products from the electrical, electronic or automotive industries were only for scrap. Therefore these findings partially support the point of view of Eltayeb et al. (2011), who provided five actions in ECO-design, which were supported by three out of five actions in this thesis. This thesis also highlighted that the best decisions in the early stages of a design can reduce the capital cost of integrating low environmental impact and recycled or innovative materials which can reduce overall life cycle emission, as suggested by the study of Rai et al. (2011).

The research's findings also support the study of Cruz and Wakolbinger (2008) that organizations should educate their employees on the environment, and health and safety by applying CSR in organizational policy. In addition, the findings also support the point of view of Harwood et al. (2011) that the most frequently used environmentally responsible activities were waste recycling, energy reduction and carbon footprint; while among socially responsible activities were staff welfare, charity and local community work. The empirical evidence strongly supports investment recovery as an important practice to improve organizations' sustainability. This relates to the views of Choi and Hwang (2015) and Zhu et al. (2008) that IR can support organizations to maximize cost saving, and has been applied in a wide range of Thai manufacturing. The findings on SResSCM impact

also support the view of Zailani et al. (2012a) that SSCM practices will lead to a reduction in resources, materials and waste.

The author's work supports the findings of Hamel and Valikangas (2004), Pettit et al. (2013) and Ponomarov and Holcomb (2009) that SRES supports the continuous adopting and developing of capabilities to create more resilience in the supply chain. Furthermore, the results also fully support the study by Sheffi and Rice (2005) that organizations should develop resilience to avoid and mitigate unforeseen disruptions as part of their strategic role. The evidence from this thesis supports findings from Fiksel (2006) that the combination of sustainability and resilience can create multiple business opportunities, as suggested in this thesis, i.e. the improvement in SC performance and the impact on organizational performance. Furthermore, the findings also highlighted that small and medium size organizations should apply SSCM and SRES when doing business with large organizations for a long period of time. This relates to the study of Moore and Manring (2009), that small and medium size organizations should consider sustainable models and enterprise resilience.

Moreover, this thesis also supports the findings from Anderson and Anderson (2009) that there was a relationship between sustainability and risk management, and also between sustainability and resilience in terms of supply chain improvement and organizational impact. This thesis will add more research to the sustainability and resilience field, Hofmann et al. (2014) having found some published papers in the existing literature combining sustainability concept in supply chain risk management research. This relates to the study by Ahi and Searcy (2013) that sustainability characteristics integrate with other factors more than the resilience concept. In addition, the empirical findings fully support the view of Mari et al. (2014) that supply chain managers found it challenging to design supply chain networks to be more resilient and offer sustainability under a state of disruption. Moreover, the findings support the study from Park et al. (2010) that organizations can gain SRES from environmental management practices, i.e. ECO-design and IR. Moreover, the evidence highlighted by the empirical research fully supports the

view of Azevedo et al. (2012) and Azevedo et al. (2013b) that green practices and SRES practices help organizations to become more sustainable.

This thesis supports the argument from Carpenter et al. (2001) that the measurement of resilience will increase better resilience outcomes. Therefore, the thesis provides a SResSCM practices measurement scale to measure the level of SResSCM implementation in organizations and suggest further improvement in the SResSCM concept. Similar to the study by Ponomarov and Holcomb (2009), organizations can decide to develop or enhance their supply chain performance by assessing current performance to scope which parts and factors need to be improved. Moreover, as Pettit et al. (2013) found, there is a positive correlation between increased SRES and operating performance, so this thesis supports that increasing the level of SResSCM implementation will support SC performance in organizations. Furthermore, this thesis also confirms the study by Nils-Ole et al. (2015) that SRES can be quantified through i) customer service, ii) market share and iii) financial performance. Furthermore, the author's empirical research also added the view of Govindan et al. (2015) that there are other factors which can enable organizations to achieve customer satisfaction at the desired level, i.e. IEP, COL, ECO and IR. The results support the findings of Thun and Hoenig (2011) that companies, with a high implementation degree of reactive supply chain risk management show better supply chain performance.

Furthermore, this thesis tries to fill the research gaps provided by Winter and Knemeyer (2013), as the existing literature pays attention to individual dimensions of SSCM. Hence, this thesis investigates all dimensions of SSCM and expands the measurement scale to measure SSCM and SRES practices at the same time. Moreover, the evidence from this thesis also suggests that SRES should be implemented along the supply chain, instead of simply within individual organizations, as advocated by Ambulkar et al. (2015). Moreover, this thesis also supports the suggestions from Ahi and Searcy (2015) and Pettit et al. (2013) about developing conceptual framework, by providing a SResSCM conceptual model to apply in organizations to measure SResSCM practices, and suggesting appropriate

practices to help organizations to become more sustainable and resilient. Moreover, the empirical findings also confirmed the results from Sweeney et al. (2015) that Government support for education and training is driving the adoption of SCM. Lastly, this thesis also supports the findings of Kamolkittiwong and Phruksaphanrat (2015) that the critical factors to the implementation of GSCM (or SSCM in this thesis) are regulation, support from top management, market, consumer and organizational strategy. This is related to the study by Zhu and Sarkis (2004) regarding support from top management down to employees: "among all the items, support from top and mid-level managers was a key to implementing GSCM successfully" (p.282). Consequently, this could further add to the findings on the SSCM and SRES field in the existing literature.

Consequently, all stakeholders (i.e. suppliers, customers and shareholders) are important factors for supporting organization to achieve SResSCM goals. Thus, SResSCM framework is for supply chain rather than individual organization.

7.4 Sustainable and resilient supply chain management (SResSCM) in Thailand

According to Phase One to Phase Three of the research methodology for this study, all stages were conducted in Thailand, which was the research area for this study. Thai manufacturing was used for developing and testing a new framework of SResSCM. For this thesis, the characteristics of Thai industry can be explained as, for electrical industry, Thailand is one of ASEAN's largest production centres in the electrical appliances section, which supply the global household appliance as air conditioning units and refrigerators (BOI, 2015b). Moreover, for electronic industry, main electronics exports were computer components and integrated circuits (IC) as Thailand being one of the main manufacturing bases for these products in the ASEAN region (BOI, 2015b). While, for automotive industry, Thailand has the Tier-1 suppliers as the most manufacturing in this industry, more than half are automotive component companies, which more than 50% of the top 100 auto parts manufacturers in the world are in Thailand. (BOI, 2015a). Moreover, Wong and

Boon-itt (2008) mentioned “the Thai automotive industry is moving towards higher level of maturity because many major international automakers have set up automotive assembly plants and supply bases in Thailand” (p.404). Furthermore, electrical, electronic and automotive industries in Thailand are growing sectors in which the growths of Thailand’s exports and imports for these industries have increased sharply. Moreover, Thai manufacturing has several motivations to adapt SResSCM concept, such as environmental regulations, marketing demands, organization internal initiative, unforeseen disruptions and their past experience, are the major factors that positively affect the adaption of SResSCM concept. Therefore these selected industries are appropriate research context for this study.

For Phase One, there were three electronic organizations, who produce integrated circuits, two transportation organizations, and one electrical organization, where manufacture air-conditioning, while Phase Two encompassed 91 electronic organizations, 8 electrical organizations, where are 55 electrical/electronic manufacturing and 30 electrical/electronic suppliers and 14 automotive organizations, which most are in automotive suppliers (9 companies) and automotive manufacturing (5 companies) (Figure 5.4). As noted in Section 6.2.1, Phase Three had five organizations in the electrical industry, where two electrical manufacturing and three electrical suppliers, five organizations in the electronic industry, which are three companies produce integrated circuits and two electronic suppliers, three organizations, where are all auto-part suppliers, in the automotive industry and one transportation organization.

According to the results from these three phases, it can be seen that most respondents were operations managers in their organization, i.e. supply chain manager, logistics manager, operation manager or purchasing manager. Moreover, most of the organizations were 1st suppliers in the supply chain. The respondents came from large organizations located in Bangkok and Central Thailand, with revenues of more than £4 million per year. The results gained from this study represent information obtained from the main group of the study, being electrical and electronic manufacturing in Thailand.

Based on the existing literature, there have been few papers on SSCM or SREs in the Thai context. Thus this study will help practitioners to find research that uses Thailand as the main context. However, the results from this study are similar to some previous studies, for instance, that of Kamolkittiwong and Phruksaphanrat (2015) who found that regulation was one of the most critical initiating factors in the development of environmental strategy. This result was similar to the effect of SResSCM practices on IEP factors in this study where "the organization follows Government/BOI legislation to conduct the business (IEP_03)". Hence, top management needs to support organizations in implementing SResSCM practices and SResSCM definition, and including their employees in their vision, which is directly affected by the organizational policy. Moreover, Zhu and Sarkis (2007) found in their study that the Chinese Government forced Chinese manufacturers to implement GSCM practices. Thus, if the Thai Government wants to improve supply chain performance in Thailand, they need to force Thai manufacturing to implement SResSCM practices in organizational policies and procedures. Moreover, support from Government is also an important factor, as Yusuf et al. (2013) found that smaller organizations needed financial and technical assistance, with continuing support from giant organizations or Government. Therefore, the Thai Government should focus on supporting smaller and medium-sized organizations in the supply chain as well. Regarding the results from this thesis, it can be seen that "when it has different company size, it has different SResSCM adoption". So this is an important that managers or higher positions are aware of these limitations and variations when studying and preparing to implement SResSCM practices as there is "no one size fits all".

Furthermore, it can be concluded that most organizations in these industries applied SSCM and SRES (or SResSCM) practices in their policy, but at different implementation levels, i.e. considering implementation, partial implementation and full implementation. This might be because organizations in the same supply chain applied these practices in their organizations, so it would encourage other organizations in the same supply chain to enhance and apply SResSCM practices as well. However, it may be concluded that while organizations did not care about the

definition of SSCM and SRES in the literature, nevertheless they used these practices. Besides, the results suggest that the organizations applied SRES practices more than SSCM practices in their policies. The reason is that Thailand had previously suffered from huge flooding, when some organizations permanently closed, and some of them moved their organizations to other countries, so the remaining organizations needed to prepare for unforeseen disruption by drawing up plans or actions, and contacting their supply chains to operate and share information. It was found that organizations could mutually support each other through the supply chains to overcome this issue. Thus, big organizations had effective plans to maintain the survival of their supply chains in the future. Even though organizations had resilient practices in their policy, the findings suggest that they had less understanding of "resilience" in the Thai context. Thus, if organizations adopted a clear definition of SRES and knew more procedures to become more resilient, it would enable them to enhance their policy with more effectiveness and efficiency in the future. Regarding the word "sustainability", it can be seen that most organizations applied this word in their vision or policy as the business trend in Thailand. However, SSCM definition in the Thai context tends to be more environmental than other aspects. However, organizations had SSCM practices that related to all SSCM perspectives, i.e. environmental, economic and social perspectives. For instance, some organizations had ECO-design and green production in their production process, or corporate social responsibility towards their neighbourhood and their employees, or investment recovery for excess materials or scrap. Thus, most of Thai manufacturing was aware of the importance of SResSCM, but few had really implemented it, due to lack of knowledge and tools.

Therefore, this study can conclude that in the Thai context, "SSCM policy in organizations was developed from academia, while SRES policy was developed from their past experience". Thus, SResSCM outlined in this study could help organizations to develop their policy, with guidelines developed from the literature (academic) and some experts in Thai manufacturing. Moreover, most practitioners who participated in this study mentioned that SResSCM was an important policy, and that all organizations in Thailand should consider and apply it within their

supply chains to help Thailand to have more competitive advantage over other countries around the world. As mentioned in Section 6.5, Phase Three suggested that the Government might need to take more responsibility to help organizations to become more sustainable and resilient by providing support to attract investors to invest in Thailand. In addition, successful organizations should provide more support to other organizations, which are interested in enhancing their performance, by providing possible activities to implement and improve performance with SResSCM practices. Thus, if most organizations in Thailand implemented SResSCM practices in their supply chains, it would help Thailand to become a more attractive place for investment from the investor's perspective. However, based on traditional culture in Thailand, most organizations tend to focus on better price quality, which will impact on the implementation of SResSCM practices, because if organizations need to invest more money, but do not receive any positive return, they might not be interested to do it. This, then, confirms that the Thai Government or large organizations need to show positive results to improve supply chains in Thailand by becoming more sustainable and resilient.

The last point that emerged from Phase Three, which might be more important for this study, is that most organizations believed that people or employees were the main factor which helped them to achieve sustainability and resilience in their supply chains. So it can be concluded that organizations need to support their employees by providing more knowledge and understanding of SResSCM concepts. Top management should supply their employees with feedback to improve suitable SResSCM in organizations. Top-down communication and bottom-up communication in organizations are important activities. Also communication between organizations and their suppliers and customers is important as well. Organizations should share their SResSCM policy as much as possible with their suppliers and customers, to develop and improve supply chains. In doing so, employees at all levels of the organization are likely to maintain an awareness of SResSCM concepts and take steps to improve their procedures along the supply chain. Managers should also seek to establish a formal infrastructure by dedicating

human and information resources to specialize in managing and responding to real and perceived risk to organizational operations.

Thai manufacturing has begun to change their focus from single plant improvements to whole supply chains. Although, SResSCM is still a new concept in Thailand, the adoption rates shown in the empirical findings are quite high. Some organizations have recognized its importance and tried to put it into practice, but some organizations may lack experience and the necessary tools and management skills. This indicates that, in general, Thai manufacturing places high consideration on the business benefits of SResSCM practices as key determining criteria to adopt SResSCM practices. Accordingly, SResSCM practices tend to have a win-win relationship in terms of sustainability and resilience.

As these industries have received impact effect from their customers from EU with have some regulations such as WEEE (Waste Electrical and Electronics Equipment) and ROHS (Restriction of Hazardous Substances in Electrical and Electronics Equipment), therefore, these industries are necessary for business to adopt SResSCM practices, in order to respond to be the current business concern and create more competitive advantage than other countries. As mentioned before in Section 2.7, about a Green Industry Project, so Thai Government might promote SResSCM practices from this thesis to Thai industry and then give some awards to organizations, which enroll this project with certificated, that will be increase a good image of credibility and public trust.

7.5 Summary of chapter

This chapter has presented and summarized the key empirical findings of the study by integrating the existing literature review with the results of three phases of research methodology. This has enabled a final evaluation of the key gaps. SResSCM practices were developed and tested during the study, and it was found that these practices clearly had an impact on organizational performance and supply chain performance. Thus, this study will help organizations to examine their

procedures, processes and policies, and to develop these to create more sustainability and resilience in the future. The triangulation methodology for this study has enabled an extensive and in-depth view of the world of SResSCM development, and has enhanced the researchers' knowledge and confidence in the empirical findings, assertions and recommendations.

The next chapter is the conclusion chapter, which summarizes the current study and provides the theoretical and practical implications of its key findings. Also, a number of limitations and suggestions for future research are suggested.

Chapter 8 CONCLUSIONS

8.1 Thesis summary

The bulk of this study was discussed in the previous seven chapters. The study has investigated and developed a new definition of sustainable and resilient supply chain management (SResSCM) and identified SResSCM practices with existing variables, which organizations can use to improve supply chain performance. This was achieved by investigating and testing SResSCM practice variables, which were currently being applied and viewed as important by practitioners, and studying the impact after organizations had applied SResSCM practices. This chapter concludes the research findings of the study by summarizing the main theoretical purpose of this research, along with an evaluation of the managerial implications, research limitations and suggestions for further research.

As a consequence of the challenge to provide SSCM and SRES in the past two decades, there has been a growth of works conducted between these two supply chain fields. SSCM is an interesting paradigm to reduce environmental and social impacts, while retaining achievable profitability in the long term. On the other hand, SRES is an approach to use in uncertain business situations to recover business faster than competitors. Thus, these two concepts have practical relevance, and there has been restricted work on developing a combination of SSCM and SRES in one definition. The aim to develop a SResSCM framework was the researcher's wish, and to provide appropriate practices that can be implemented by organizations to improve supply chain performance. Moreover, the researcher found that the large amount of flooding in Thailand previously was a disruption that had a huge impact on people and organizations in Thailand. Therefore, SRES concept is one strategy that organizations in Thailand should adopt. Furthermore, SSCM is a concept that has received more and more interest from organizations in Thailand in the past decade. Some organizations have introduced campaigns to provide knowledge about SSCM to their employees and have devised rules in production lines to make them more sustainable. While these two concepts are separate concepts in organizational policy, the researchers

believe that if they can integrate and implement these two concepts together, it will improve organizations and supply chains, enabling them to be more sustainable and resilient in the future.

Consequently this study has applied a systematic literature review of the last two decades (papers from 2000 onwards) to develop the concept of SResSCM. It was found that there were 1,320 papers in the databases, of which 385 papers were used to conduct this thesis. There were 269 papers on SSCM, 88 papers on SRES and 28 papers relating to both (as SResSCM in this thesis). Moreover, it can be seen from the existing literature that there was a relationship between SSCM and SRES in some papers, but this relationship is not clear at this moment. Thus, SResSCM represents a new era for the concept of supply chain. For SSCM, this thesis has used the definition from Carter and Rogers (2008), who applied the concept of the triple-bottom-line from Elkington (1997). On the other hand, SRES definition for this thesis was developed by Pettit et al. (2010) and Pettit et al. (2013), who developed resilience fitness space by balancing vulnerability factors and capability factors together. Existing SSCM and SRES practices were used in combination as SResSCM practices, using results from the relevant literature. SResSCM practices combined four practices from SSCM and four practices from SRES. Furthermore, there were four supply chain performance variables which emerged from the existing literature, being operational cost (Jeffery et al., 2008), business wastage (Singh et al., 2010), environmental cost (Christiansen et al., 2003; Tsai and Hung, 2009; Zhu et al., 2005) and customer satisfaction (Beamon, 1999). It was found that SSCM practices and SRES practices had an influence on supply chain performance; thus, SResSCM practices should have an impact on SC performance as well.

A comprehensive review of the literature to date was performed to identify a set of practices associated with sustainability and resilience in SCM paradigms. There were found to be significant gaps in the body of knowledge surrounding the SResSCM field. This study presents a definition of SResSCM and SResSCM practices, and then reports on SC performance and SResSCM impact, which organizations can use to measure and enhance their strategy or policy. SResSCM indicates a new,

topical and fertile ground for research, and there is occasion to combine research methods to create theory in this field and offer suggestions to practitioners.

This study developed the initial definition of SResSCM and practices from the relevant literature. Four research questions were proposed for this study:

- RQ1. What is the current level of understanding and implementation of SSCM and SRES in organizations?
- RQ2. What could be a suitable framework of sustainable *and* resilient supply chain management (SResSCM)?
- RQ3. What would a valid measurement scale of SResSCM practices for performance improvement?
- RQ4. What is the impact of SResSCM practices on supply chain performance and organizational performance?

A three-phase methodological framework developed by Churchill (1979), DeVellis (2012) and Oppenheim (2000) was employed in this study as a rigid approach for the evolution of measurement scales and constructs and corresponding issues of reliability and validity. Based on the research objectives, research questions and hypotheses testing the empirical findings have fulfilled the objectives of the research questions and hypothesis testing.

Phase One (Chapter 4), as a semi-structured interview with the systematic literature review (Chapter 2), collectively identified four practices from SSCM and four practices from SRES for further investigation and survey testing, with four SResSCM definition variables, 24 SResSCM practices variables, 24 supply chain performance variables and 32 SResSCM impact variables in two groups according to time period, i.e. short and long-term organizational impact, and SResSCM impact, i.e. practice impact and organizational performance. Given the robust application devoted to the nine persons in Phase One, the findings were scrutinized as essential, internally valid and rigid enough to continue to the next step for testing.

Phase Two (Chapter 5) forms the main study for this thesis by testing the measurement model and structural model of SResSCM within Thai manufacturing. The respondents from these industries were taken from different databases. The number of samples from these databases was 113 respondents, i.e. 91 organizations from the electronic industry, 8 organizations from the electrical industry and 14 organizations from the automotive industry. After conducting statistical analysis, SResSCM variables from Phase One were reduced in Phase Two, and SResSCM practices with 24 variables were reduced to 16 variables and renamed with four constructs, i.e. IEP, COL, ECO and IR; SC performance variables were reduced from 24 to 15 variables with four constructs, i.e. COC, ENV, BUS and CS; while SResSCM impacts were not reduced, but rearranged into four new groups, i.e. SRESPI, LOP, STF and STG. Furthermore, PLS-SEM was used as second-generation technique for testing the measurement model and structural model for this thesis. The PLS-SEM results suggested that the SResSCM definition did not have a relation to practice, hence not supporting Hypotheses 2 and 3; however, SResSCM practices had a significant effect on supply chain performance and SResSCM impact, which supported Hypotheses 4, 5 and 6 and also answered RQ4.

Phase Three (Chapter 6) was used to validate the overall research outcomes and to ensure the research objectives had been reached. Phase Three summarized a new definition of SResSCM, and revealed a combination between SSCM constructs and SRES constructs, becoming SResSCM constructs for this study, which answered RQ1 and RQ2 too. In summary, the list of 16 SResSCM practice variables, 15 SC performance variables, and 32 SResSCM impact variables were empirically validated and confirmed. All participants confirmed that SResSCM practices could be implemented by their organizations. Moreover, the findings showed that practitioners focused on customer satisfaction, being very important for organizations, and sustainable and resilient supply chain management practices, which provided more impact on organizations.

Thus, this study confirms that there is a relationship between SSCM and SRES from the practitioner's perspective, confirming hypothesis 1. However, the relationship

between these two concepts was different in each organization according to their experience. Some organizations paid attention to SSCM rather than SRES; while some of them focused on SRES rather than SSCM. Nevertheless, Thai manufacturing generally was trying to reduce risk, improve supply chain performance and enhance customer satisfaction. So SSCM and SRES concepts were two main aspects that needed to be implemented by all organizations. Table 7.2 provides the implementation level measurement scale for SResSCM practices which could be applied by Thai manufacturing organizations to measure their implementation level, and which completely answered RQ3 of this study. Moreover, the Thai Government might need to provide the knowledge about SResSCM from this study to small and medium organizations, and support large organizations to be more sustainable and resilient than before. Once supply chains in Thailand are strong enough, this will be a competitive advantage for Thai manufacturing to attract foreign organizations to invest in Thailand. Thus, the Thai Government and large organizations are the main players to drive the improvement of supply chains in Thailand. Consequently, this finding recommends that we should combine SSCM and SRES concepts to promote improvement in organizational performance and supply chain performance.

However, employees and workers in organizations are an important factor as well. As you can see in this study, lots of managers highlighted that even though their organizations had good policies or best procedures, if employees or workers were not aware of these or did not respond, as they should, the organizations will not have achieved their goals. Thus, the important thing that emerged from this study was that organizations needed to focus on improving and enhancing the understanding of their employees and workers on SResSCM framework in order to become more sustainable and resilient in the supply chains.

As the results from this study show, the implementation of SResSCM practices in organizations will change or add more practices to those currently in use; however, after these SResSCM practices have been implemented, there will be an improvement in SC performance, and also some impacts on organizational

performance, as mentioned in Section 7.2.4. Thus, organizations could apply this thesis as the standard base and then develop their own practices, which are most suitable for their organization. The improvement will be different in each organization, but the researchers believe that this improvement will be a good sign for supply chains in Thailand in the future.

8.2 Contributions of the thesis

This research provides a valuable contribution for the advancement of the fields of SSCM and SRES by investigating SResSCM framework and practices with a practical perspective in the context of Thai manufacturing. Based on the results of this thesis, it can be confirmed that SSCM and SRES are important for organizations around the world, because they both have potential to improve supply chain performance. Then, the researcher discovered the house of SResSCM that can provide better understanding about the relationship between SSCM and SRES for organizations to improve better performance.

Moreover, the findings also suggests that organizations should have provided a clear definition of SResSCM to their employees or workers and implement SResSCM practices into their policy for current used and future plan because organizations would gain more benefits rather than implement these concepts separately. To improve better performance in supply chain and organization with SResSCM concept, the research provides SResSCM practices measurement scale as a tool for all organizations, this tool can be used to assess current implementation level and plan to implement practices in the future. Thus, organizations can develop their policy and practices that improve their performance to be more sustainable and resilient than before. As the development of a reliable and valid scale was a fundamental goal of this study, the multi-dimensional SResSCM instrument developed in the study makes an important contribution to the knowledge as discussed in the following sections.

8.2.1. Contribution to knowledge

This study adds a contribution to the body of knowledge by investigating the area of combined definition between SSCM and SRES into one definition as sustainable and resilient supply chain management (SResSCM), which was previously under studied. Opportunities have been taken to expand the understanding of SSCM and SRES from practitioners back to academia. Although there have been some research studies on SSCM and SRES during the last two decades, the number of studies relating to the area of SResSCM is still quite low. Therefore, this thesis provides practitioners' perspective about the relationship between SSCM and SRES into the existing literature. Moreover, this thesis also suggests that all supply chain members should cooperate to apply SResSCM concept in supply chains because they will earn more benefits rather than apply in individual organization. Furthermore, it also highlights that SSCM and SRES concepts have received more interest from Thai manufacturing than before and the reason might be that organizations in Thailand have more experiences to overcome with some unforeseen disruptions in the past so Thai manufacturing need to adapt and apply suitable policy and prepare solutions for the future. In addition, it can be concluded that government and large organizations has been found to have the major role in developing SResSCM in the supply chain.

The empirical findings provide insights into the level of understanding of SSCM and SRES in Thailand, from Phase One to Phase Three. The key message from this study is that Thai manufacturing understands SSCM definition better than SRES definition, but organizations tend to use SRES practices more than SSCM practices. Moreover, it can be concluded that if Thai manufacturing were to more fully understand definitions of SSCM and SRES, it would help organizations to be more sustainable and resilient. In addition, the practitioners from this thesis also suggested that organizations would be happy if they have opportunity to discuss with scholar to improve their practices to be better than before.

Consequently, this thesis created and developed a robust conceptual framework of SResSCM and provided a house of SResSCM, as presented in Figure 7.2. This

definition was developed during data collection of this thesis; practitioners validated this definition and returned the findings to literature. Therefore, this would helps to provide more insightful information for SResSCM study.

This thesis also provides a valid measurement scale of SResSCM practices, as shown in Table 7.2. Organizations can use this table and assess their implementation practices level by themselves. The key message from this is that, while there are different implementation levels, but Thai manufacturing has planned to implement SResSCM concept and practices that suitable to their industry and supply chain members. So it can be confirmed that Thai manufacturing pay attention to improve their performance to be better than before. Furthermore, this study provides a possible tangible measurement for SRES, which, according to the literature, is quite difficult to measure because it is an intangible concept. Thus, this study contributes to the measurement of SRES concept with tangible practices.

Furthermore, this thesis follows suggestions by Hassini et al. (2012) and Pettit et al. (2013) by considering multiple measure for each sub-factor and using existing indicator for implementation practices in organizations and supply chain. Knowledge of win-win opportunities existing in a developing country such as Thailand, with many of the same characteristics as other countries, is important to further the adoption of SResSCM practices. However, Thai people are often excited about new things, but they do not always accept or follow new concepts, relying instead on their previous understanding, or they may accept and follow new concepts to start with, but as time passes, they will not continue to do so if no one examines or checks their work.

This thesis found that company size is one factor that affects implementation of SResSCM practices in supply chains as large companies have implemented SResSCM practices more so than small or medium companies. Moreover, when large companies implemented SResSCM practices, it will impact small or medium companies as well because they need to follow with large companies' requirement

if they would like to be a partner with larger companies; hence SResSCM practices should end up being applied across the entire supply chain.

Accordingly, globalization increases multinational enterprise (MNE) investment in developing countries, where their subsidies can be expected to self-regulate environmental performance more than domestic organizations do. Experience or even lessons from these foreign enterprises to improve environmental performance can be learned by domestic enterprises (Zhu and Sarkis, 2004). Consequently, organizations in Thailand have been influenced by mother organizations outside Thailand on the concepts of SSCM and SRES, which have been implemented and applied with good results. So Thai manufacturing has followed the concepts of developed countries rather than developing new concepts themselves.

Therefore, other industries or countries could apply this SResSCM framework and measurement scale to measure current implementation levels of SResSCM practices, and consider implementing appropriate SResSCM practices most suitable for individual organizations. However, it cannot be guaranteed that all organizations will get the same results from this thesis, but they are likely to be similar to the findings from this thesis.

Moreover, organizations also have to manage and maintain perceptions from various stakeholders, while they also need to overcome any disruptions. This necessitates that organizations should develop core comprehensive practices or concept to improve supply chain performance and organizational performance. So, regarding to stakeholder theory and contingency theory in this thesis, it can be concluded that these theories may influence SResSCM at three main points in the sustainable and resilient progression: 1) in the establishing of awareness in organizations; 2) in the adoption of sustainable and resilient goals; and 3) in the implementation of sustainable and resilient practices. Consequently, the empirical results and recommendations of this thesis are expected to be of significance for policy aimed at promoting sustainable and resilient supply chain management

development in Thailand based on SResSCM framework and practices. In summary, as presented in Figure 7.4, SResSCM practices are found to have the significant role in the improvement of supply chain performance and they also provides the impact on organizational performance when organizations implemented successfully.

8.2.2. Contribution to practice

The academics and practitioners discussed improving added-value benefits for supply chain performance by integrating SResSCM along the entire supply chain. This study has proposed the relationship between SSCM and SRES by reviewing the existing literature and conducting triangulation methodology (inductive and deductive) in the Thai manufacturing sector. Further, it can be seen that SResSCM practices have already been applied in some organizations' strategies; however, it was found that there were different levels of implementation, i.e. considering implementation, partial implementation and full implementation of these practices.

The proposed model to assess organizations in terms of the implementation level of sustainable and resilient practices also represents a useful contribution for managers. It serves as an important framework in supporting decision-making related to sustainability and resilience in SCM. An interesting point for this thesis is that the results show that organizations did not pay attention to the definition of SSCM and SRES (as SResSCM in this study) from the literature, but had been applying these practices from the literature in their policies and procedures (as SSCM/SRES definition was not seen as significant for SResSCM practices).

Thus, organizations should study these definitions from the existing literature to gain more understanding of these concepts in order to apply them in practice. It can be seen that if employees understand the purpose of organizational policy, they are more likely to realize their responsibilities and focus on aims to increase organizational performance. In this way, supply chain managers can adjust organizational behaviour to achieve better levels on the measurement scale of SResSCM practices in order to: 1) reduce risks and impacts while improving

organizational sustainability efficiency; 2) improve the supply chain ability to cope with unexpected disturbances; 3) prepare for the impact of the implementation of SResSCM practices on organizational performance. Supply chain managers can use this knowledge process to respond to disruptive events more effectively and with increased confidence.

Regarding SResSCM practices, 16 activities from this study were highlighted as being important practices to apply in an organization to enhance supply chains in becoming more sustainable and resilient. The study also suggests that organizations run very different activities in promoting SResSCM. Therefore, managers should carefully check appropriate practices for the interaction that is needed in their organization, considering the internal and external plan (IEP) construct, combining recovery and external pressure. Thus, organizations should focus on both sides, internal and external factors. This is because they need to prepare themselves and also apply external legislation in their organizations, i.e. Government legislation, or Board of Investment policy, if they wish to improve their supply chain performance. Furthermore, investing in recovery construct provides guidelines for organizations to apply three activities (IR_01 to IR_03) in their procedures. It also shows that organizations need to focus on the economic perspectives in sustainable schemes as well.

Moreover, ECO-design activities should be applied at the first stage of new product development in an organization as the global market is paying attention to the application of ECO-design in all products. The last construct of SResSCM practices is collaboration. It can be seen that collaboration with employees, suppliers and customers is an important activity for organizations. Therefore, organizations should pay attention to communication across their entire supply chain to increase efficiency and effectiveness in collaborative activities. Thus, the managers need to consider the required activities when implementing practices for skilling employees. In addition, organizations should evaluate SResSCM practices and should not view the dimensions of SResSCM independently. Managers should be

cognizant that increasing each dimension of SResSCM practice collectively influences supply chain performance and SResSCM impact.

The significant relationship represented by Hypothesis 4 suggests that SResSCM practices positively influence supply chain performance. Considering supply chain performance in this thesis, it can be found that there were 15 variables in four main constructs related to the existing literature, i.e. customer and operational cost (COC), environmental cost (ENV), business wastage (BUS) and customer satisfaction (CS). Therefore, managers could look at supply chain performance and define how interaction needs to be shaped within their organization. The interaction can differ between departments; therefore the interaction of each individual department should be considered to attain the level of improvement in supply chain performance that fulfills the needs of the organization. Thus, this study provides a set of valid and reliable measurements for measuring the implementation level of SResSCM practices, and further benchmarking and comparing SC performance across different organizations. The measurements developed in this thesis capture the different aspects of supply chain performance and organizational performance, and can thus be considered better measures of SResSCM practices.

Moreover, the results also show that SResSCM practices have impact on organizations in terms of time, so organizations should study these impacts before implementing these practices. Therefore, this thesis has identified which practices can help businesses to be more sustainable and resilient in their supply chains, and how effective SResSCM can support these practices. Managers should also play an active role in making sure that the resources of their organization are aligned with the changing needs of the organization and the marketplace. They must be willing and able to make changes to their resource portfolio, which may involve making major adjustments.

Globalization may increase exports from developing countries such as Thailand to developed countries, where customers might use environmental performance as a supplier-selection criterion. This could exert pressure on domestic enterprises in

Thailand to self-regulate, and contribute to the improvement of individual organizations and their SCs, meeting or surpassing industry best practice and obliging them to be more rigorous in establishing priorities, targets and goals in terms of sustainability and resilience. Supply chain managers are encouraged to examine the implementation level of SResSCM practices to ensure more effective structure and more efficient response times. Moreover, it makes it possible to implement functional benchmarking approaches in Thai manufacturing and rank organizations according to their SResSCM practices score (from 1 to 5 of implementation level). This serves as a motivation for organizations to reach a better position among their competitors in the supply chain, and to be more rigorous in establishing priorities, targets and goals, in terms of sustainability and resilience. As mentioned by Rao (2002), a major portion of the world's manufacturing will take place in Southeast Asia in the coming decade. This is similar to the studies of Zhu and Sarkis (2004) who suggested that developing countries such as Philippines, Indonesia, Malaysia and Thailand may have similar market and socio-cultural attitudes to GSCM practices when compared to other countries, and thus organizations in these countries can learn lessons from the potential relationships identified in this study. Therefore SResSCM practices will represent an even more critical strategy for Thai manufacturing.

8.3 Thesis limitations and suggestions for future research

This study has attempted to investigate the relationship between SSCM and SRES and integrate them into the new definition of "Sustainable and Resilient Supply Chain Management (SResSCM)". Moreover, it has defined SResSCM practices for theoretical and managerial implications related to supply chain performance and its impact on Thai manufacturing. However, this study, like others, has its limitations:

1) Based on the systematic literature review approach, there is only a limited risk of having ignored relevant materials. However, as the research has been designed to investigate SSCM and SRES, both highly studied areas, it was not possible to review all available materials pertaining to these fields, i.e. books

and trade magazines that might contain practical case studies and results relating to SResSCM in different industrial sectors. Furthermore, there could be journal articles on these fields, which have been published since the research was completed and the thesis written-up.

2) The participants in Phase One were electrical and electronic industry and distributors only, with none from the automotive industry. Hence it could be argued that this approach only provided perspectives from these industries relating to the existing literature. Moreover, the number of cases in Phase One was small, with nine participants from six companies. It might be a limitation of this research not to cover the industry across the whole of Thailand. Moreover, care and effort was put into each interview in order to ensure the best use of the time available for each interview, and that all relevant topics were covered. Despite the time constraints, the visit/interview time for each participant was an average of one and a half hours, and everything was scheduled to a carefully planned time-frame.
3) The selection of participating candidates was a possible limitation for this study. They were selected in collaboration with a contact person at each organization, and as a result of their knowledge pertaining to aspects of the areas being researched. As participants were not selected randomly, it is possible that the data reflects some bias in responses.
4) In the qualitative sampling (Phase Two), the members of all the databases were used as a representative sample of Thai manufacturing in the electrical, electronic and automotive industries; thus the results are generalizable only to the extent that these members resemble the population of Thai manufacturing. While this was considered the most convenient and effective method of reducing bias, some may have remained.
5) The response rate of this study was quite low; however, G*Power was applied to calculate the minimum sample size, and the response rate produced adequate data for analysis. Moreover, this study applied PLS-SEM to analyse measurement model and structural model with bootstrapping procedure; thus this approach would solve the issue of low sample size.

6) There were three industries in the sample from Phase Two. Therefore, the different supply chain environments in each industry could have led respondents to answer the questionnaire differently. 80% of the sample was from the electronic industry, so this study focused on the electronic industry more than other industries, which would make the results less generalizable.
7) This study did not use actual financial figures, so the researchers cannot confirm whether positive or negative economic performance actually occurred.
8) This study recommended the activities of 16 SResSCM practice variables in four constructs that organizations could use. However, this by no means represents an exhaustive list.

Even though, the limitations having been stated but this thesis has been provided several unique and significant contribution to SResSCM field, the last section of this thesis consists of recommendations for future research, as follows:

1) Future research could use longitudinal analysis in studying SResSCM practices as a means of providing a clear picture concerning the effect of SResSCM. A good example would be to perform a comparison on the outcomes of SResSCM before and after the adoption of SResSCM practices by comparing supply chain performance improvement in this thesis.
2) This thesis did not investigate the cost to implement SResSCM practices in organizations, so future research can study about the cost to implement SResSCM by comparing between large organizations and SMEs to provide more information for decision-making process with the best alternative for each organization.
3) As this thesis suggests that SResSCM concept and practices need to adapt and apply along the supply chain, but the researcher did not mention the constraints to implement SResSCM practices in supply chains, thus future research might consider and study barriers to implement SResSCM practices in supply chain.

4) Regarding this thesis applied stakeholder theory and contingency theory with SResSCM concept, there is also an opportunity to study the relationship between SResSCM and others theories, such as institutional theory or resource based-view theory, etc.
5) This thesis provides SResSCM practices as basic requirements that organizations should have; so future research might develop and add more advance practices, which related to different behavior for each industry.
6) Finally, this thesis is a first step to study SResSCM so further study could contribute the development of new theory that provides deeper and richer knowledge of SResSCM.

8.4 Closing remarks

Overall, the current research represents one of the first empirical efforts to systematically investigate the relationship between SSCM and SRES and develop the new definition of "Sustainable and Resilient Supply Chain Management (SResSCM)" in a developing country, as presented in chapter 7 and restated here, as "*the management of total resources i.e. materials, information, capital flows, human resources, technology and marketing, by integrating sustainable and resilient practices to enhance supply chain performance at the desired level of production and to increase customer satisfaction by coordinating organizations between the entire supply chains*". As the concept of SResSCM is complex and involves a network of organizations in the supply chain of products and processes, its entire domain cannot be covered in just one study. This study has considered the case of Thailand, but the results of the analysis could have a significant bearing not only for Thailand. The implementation level measurement scale of SResSCM practices in this study will help organizations to measure their current levels and plans for further improvement in the SResSCM field by preparing to see SC performance improvement and organizational performance impact. Future research using different methodologies and time-frames could give further insight into this fast developing topic for other developing countries. Therefore, this thesis would like to campaign Thai manufacturing to adapt or implement SResSCM

practices in organizations because SResSCM concept is an important practice to implement for all organizations around the world.

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APPENDIX A: The Semi-structured Interview Protocol

To whom it may concern

My name is Worawat Joradon. I am a PhD student at the University of Hull, UK. My research theme is about sustainable and resilient supply chain management. These questions, you are holding, are a part of my research that aim to review an understanding of sustainable and resilient supply chain management in your company.

Participation in this study is voluntary. It will involve an interview of approximately one or two hours in length to take place in a mutually agreed upon location. You may decline to answer of the interview questions if you wish. The data you will provide in this interview will be treated with the highest confidentiality. Your name and your company will not be identified or disclosed without the evidence of your permission. You also have all rights not to answer any question if you do not want to, however, it would be very grateful.

Should you have any concerns about the conduct of this research project, please contact the Secretary, HUBS Research Ethics Committee, University of Hull, Cottingham Rd, Hull, HU6 7RX; Tel No (+44) (0)1482 463536.

Thank you so much for your cooperation.

Yours truly,
Worawat Joradon
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UNIVERSITY OF Hull

Dear interviewee,

This semi-structured interview is being undertaken to review and build knowledge insights in to sustainable and resilient supply chain management based on Thai electronic industry. This research is directed by Dr.Claudia Colicchia and Prof.David B. Grant, and conducted by Mr.Worawat Joradon, Ph.D. student at Logistics Institute, Business School, the University of Hull, UK. All the data requested will be used for academic research purpose only and used in strict confidentially. Should you have any concerns about the conduct of this research project, please contact the Secretary, HUBS Research Ethics Committee, University of Hull, Cottingham Rd, Hull, HU6 7RX; Tel No (+44) (0)1482 463410; fax (+44) (0)1482 463689.

Section A: General background information and company's profile

Company:
_____

1. Could you please tell me about your company's background? Type?
2. Could you please tell me about your company's primary product and product range?
3. What is your market position? Who is your main competitor?
4. How do you define your company' position in your supply chain?

4th Tier supplier	3rd Tier supplier	2nd Tier supplier	1st Tier supplier	Focal firm	1st Tier customer	2nd Tier customer	3rd Tier customer	4th Tier customer

5. Please indicate your company's main activity:

(_____) Electronic manufacturing (OEMs)
(_____) Electronic suppliers (supply for raw materials, electronics' components)
(_____) Electronic distribution (support in transportation, or warehousing)
(_____) Other, please
specify_____

6. Annual revenues of the company

(_____) Less than 50 million Baht
(_____) Between 50 million Baht to 200 million Baht
(_____) More than 200 million Baht

7. Size of the organization

(_____) Small firm (up to 50 employees)
(_____) Medium firm (51 to 200 employees)
(_____) Large firm (more than 200 employees)

Section B: Sustainable and resilient supply chain management practices (SResSCM) and supply chain performance in company.

Supply chain activities:

1. How many suppliers/third party service providers do you have? Does your company have others suppliers/3PLs in your contact for unforeseen situation? Do you think your company has sufficient suppliers contacts?
2. How many people are working in supply chain or related activities? Which position has responsibility for sustainable and resilient supply chain management practices?
3. Could you explain logistics and supply chain costs in your company?
4. What is your current percentage capacity utilisation in production and supply chain?

Sustainable supply chain management practices:

1. What is sustainable supply chain management in your understanding?
2. Could you please tell me about your sustainability policy and procedure?
3. Why did your company make a decision to implement sustainability policy? How much is it important?
4. What sustainable supply chain management practices (related to Eco-design, green production, social responsibility, and investment recovery) do you use?
5. What are the concerns with your supplier/operations system/customer, when your company uses sustainability policy?
6. Does your company have an extra cost for sustainability practices? If so, why does your company invest in sustainability?
7. What are the impacts of sustainable supply chain practices on your company's performance? In the short-term (0-3 years)? In the long-term (more than 3 years)?
8. Does your company have a future plan for sustainable supply chain management practices? In 3 years? In 5 years?

Supply chain resilience management practices:

1. What is supply chain resilience management in your understanding? Does your company have procedure for supply chain resilience?
2. Does your company have supply chain resilience management? Or supply chain risk management?
3. Could you tell me about company's policy when company face some disruptions? How to be prepared, maintain, and recovery from that situations?
4. What are the disruptions and impacts that your company faced in the past? How was your company response? Do you have action plan for the future?
5. Is supply chain resilience management important in your company? If so, why?
6. What supply chain resilience management practices (collaboration, recovery, external pressure, and connectivity) are used in your company? Why? Does your company have others supply chain resilience management practices (related to vulnerabilities and capabilities factors)?
7. What is the resilience practice that concerns with your supplier/operations system/customer when your company implemented?

8. During any unforeseen situation, does your company support its suppliers in taking any critical decision for your materials?

Sustainable and resilient supply chain management practices:

1. Does your company have goals for sustainable and resilient supply chain management?
2. What are problems that are found in implementing sustainable and resilient supply chain management practices?
3. In your opinion, do you think that sustainable supply chain management and supply chain resilience are related together? Why? Why not?
4. How can your company further improved sustainable and resilient process?
5. Does your company share process/practices/information to their suppliers/customers about sustainable and resilient supply chain management?
6. How do you ensure that your suppliers/customers are following the same line of sustainable and resilient policy?

Sustainable and resilient supply chain performance measurement:

1. What is performance measurement in your understanding?
2. What sustainable supply chain/supply chain resilience measures does your company use and need?
3. In your opinion, which are the most appropriate sustainable and resilient supply chain measures used in your company?
4. What are key performance indicators (KPIs) for performance measurement in your company?
5. What are the barriers to measuring sustainable and resilient performance metrics in your supply chain?
6. What are the direct/indirect benefits of incorporating sustainable and resilient supply chain performance measures within a supply chain performance framework?

Please fill the table considering the following symbols, to consider the relationship between sustainable supply chain practices and supply chain resilience practices.

A – sustainable practices has a positive impact to resilience practices
B – resilient practices has a positive impact to sustainable practices
C – sustainable practices and resilient practices has a positive impact together
D – sustainable practices and resilient practices are unrelated

For example, if **Eco-design** has a positive impact to **External pressure**, put A in the column. On the other hand, if **External pressure** and **Social responsibility** has a positive impact together, put C in the column.

Resilient / Sustainable	Collaboration	Recovery	External pressure	Connectivity
Eco-design				
Green production				
Social responsibility				
Investment recovery				

Sustainable supply chain practices

Supply chain resilience practices

Definitions:

Factors	Definition	Sub factors
Eco-design	R&D to produce product more environmental friendly	Design of products for reduced consumption of material, design of products for reuse, recycle, recovery.
Green production	Production that produce materials from green materials with green process for green product	Reducing transportation cost, tracking environmental information, environmental compliance and auditing programs, monitoring emission and waste production, limiting carbon and other emissions.
Social responsibility	Ability to maintain well-being of workers and social around the company	Worker welfare, social impact,
Investment recovery	Investment recovery requires the sale of excess inventories, scrap, and used materials, and excess capital equipment	Sale of scrap and used materials, sale of excess capital equipment
Collaboration	Ability to work effectively with other entities for mutual benefit	Collaborative forecasting, customer management, communicators, postponement of orders, product life cycle management, risk sharing with partners.
Recovery	Ability to return to normal operational state rapidly	Crisis management, resource mobilization, communications strategy, consequence mitigation
External pressure	Influences, not specifically targeting the firm, that create business constraints or barriers	Competitive innovation, social/cultural change, political/regulatory change, price pressures, corporate responsibility, environment change
Connectivity	Degree of interdependence and reliance on outside entities	Scale of network, reliance upon information, degree of outsourcing, import and export channels, reliance upon specialty sources

Section C: Interviewee information

Name: _____

Your job title/area(s) of expertise: _____

For how long have you been working in this company: _____

Email: _____

Contact number:_____

Note, "The data you will provide in this interview will be treated with the highest confidentiality. Your name and your company will not be identified or disclosed without the evidence of you permission".

APPENDIX B: Questionnaire Survey for Phase Two

Dear Respondent,

Hull University Business School is conducting research on performance measurement and its impact on sustainable and resilient supply chain management in the Thai electronic industry, and seeks your valued opinion regarding sustainable and resilient supply chain management.

We kindly invite you to take part in this survey, which will take approximately 15 - 20 minutes to complete. It is divided into 5 sections:

- Section A: deals with the definition of sustainable and resilient supply chain management;
- Section B: deals with sustainable and resilient supply chain management practices;
- Section C: deals with sustainable and resilient supply chain management and performance measurement;
- Section D: deals with short- and long-term impact of sustainable and resilient supply chain management;
- Section E: will ask general information about you and your company.

Your participation is very important for the completion of this research. Your responses will be kept strictly confidential and only aggregate data will be analysed. The more accurately your responses reflect reality, the more valuable they are to our research efforts. If you have any questions regarding any aspect of this research, please do not hesitate to contact me.

This is an anonymous questionnaire. Please ensure that you do not write your name, or any other comments that will make you identifiable, on the attached questionnaire. By completing the questionnaire you are consenting to take part in this research.

Thank you very much in advance for your collaboration with this research.

Yours sincerely,

Worawat Joradon
PhD student
Business School
University of Hull
Cottingham Road,
Hull, HU6 7RX, UK
T: +44 1482 347549
Email: w.joradon@2014.hull.ac.uk; worawat.j@bu.ac.th

Key terms adopted:

Factors	Definition
Sustainable supply chain management	The strategic achievement and integration of an organization's social, environmental, and economic goals through the systemic coordination of key inter-organizational business processes to improve the long-term economic performance of the individual company and its value network
Supply chain resilience management	The ability to prepare for unforeseen disruptions with the ability to respond and recover from them faster than competitors do
Sustainable and resilient supply chain management	The management of materials, information and capitals flows along the supply chains with three dimensions as environment, economic, and social perspectives for the situation between before-during-after disruption period by integrate vulnerabilities and capabilities factors to maintain continuity of operations at the desired level of connectedness and control over structure and function
Eco-design	R&D to produce product more environmental friendly
Green production	Production that produce materials from green materials with green process for green product
Social responsibility	Ability to maintain well-being of workers and social around the company
Investment recovery	Investment recovery requires the sale of excess inventories, scrap, and used materials, and excess capital equipment
Collaboration	Ability to work effectively with other entities for mutual benefit
Recovery	Ability to return to normal operational state rapidly
External pressure	Influences, not specifically targeting the firm, that create business constraints or barriers
Connectivity	Degree of interdependence and reliance on outside entities
Short-term (time)	The period of time between your company implemented SResSCM practices until three years
Long-term (time)	The period of time that your company implemented SResSCM practices after three years onward

Section A: *Sustainable supply chain management and supply chain resilience management*

In this section, please indicate your perception of the relationship between sustainable supply chain management (SSCM), supply chain resilience management (SRES), and sustainable and resilient supply chain management (SResSCM) according to your understanding.

Definition	Your perception				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Sustainable supply chain management supports the company to operate a supply chain resilience management					
Supply chain resilience management supports the company to operate a sustainable supply chain management					
Sustainable supply chain management has a positive effect on sustainable and resilient supply chain management					
Supply chain resilience management has a positive effect on sustainable and resilient supply chain management					

Section B: *Sustainable and resilient supply chain management practices*

In this section, you will be asked to assess sustainability dimensions (as environment, economic, and social) and resilience dimensions (as vulnerabilities and capabilities) that are currently applied in your operations. For each statement, indicate the extent of the applied based on your company's practices of your products, organization, and operations. You can answer "Do not know" for any subject for which you do not have personal knowledge.

Items	Company's level					
	Do not know	Not considering	Planning to consider	Considering it currently	Initiating implementation	Implementing successfully
The company adopted environmental concerns when designing their products/processes						
The company designs products than can be re-used and recycled						
The company designs products that focusing on the reduction of resource consumption and waste generation in product usage						
Green purchasing in the company purchases products that are more environmentally friendly						
Green production in the company has a low resource consumption						
Green warehouse and transportation in the company has the ability to reduce waste and carbon emissions to the environment						
The company has well-defined social responsibility practices and has some good activities for socials/ neighbourhoods						
The company follows basic requirements of the department of labour for giving working welfare and safety for employees						
The company has a programme to develop their employees or provides more academic support than business for youth internships to improve skills to invent a new design/product in the future						
The company sells scrap and used materials to certified waste disposal companies						
The company audits their waste disposal companies to ensure it processes waste correctly						
The company uses the policy of Board of Investment (BOI), Thailand as procedures for waste disposal						
The company effectively employs collaborative demand forecasting techniques by using shared data						
The company's customers are willing to delay orders when the company's production capacity is hampered						
The company supports or advises important information to their suppliers and customers for unforeseen disruptions						
The company can quickly provide a formal response team of key personnel, both on-site and at corporate level						
The company takes immediate action to mitigate the effects of disruptions, despite the short-term costs						
The company has a contingency plan for unforeseen disruptions						
The company follows Government/BOI legislation to conduct business using tax, or import-export criteria						
The company implements basic requirements that customers request						
The company uses customer feedback to develop their products/productions						
The company outsources operations to various suppliers						
The company has the same standard within its supply chains as ISO14001 (linkage between suppliers-manufacturers-customers)						
The company's suppliers receive information about customer requirements to support the production in the company						

Section C: *Sustainable and resilient supply chain management and supply chain performance*

In this section, please indicate your perception of the extent of your company's supply chain performance in each of the following areas that your company has achieved during the past year.

Supply chain performance		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Operational cost	The company can decrease expenses of materials purchasing					
	The company can decrease expenses on energy consumption					
	The company can decrease fees for waste treatment					
	The company can decrease inventory levels in their warehouse					
	The company can decrease the cultural changes that have had significant impact					
	The company can increase cooperation between suppliers/customers for green packaging					
Business wastage	The company can reduce air emissions					
	The company can decrease consumption of hazardous materials					
	The company can decrease scrap rate					
	The company has increased production lines					
	The company improved competitive innovation over competitors					
	The company improved an enterprise's environmental situation					
Environmental cost	The company can decrease expenses for environmental accidents					
	The company can decrease expenses for waste discharge					
	The company can decrease effluent waste					
	The company has increased number of certificated waste disposal lists					
	The company has increased purchasing environmentally friendly goods					
Customer satisfaction	The company increased in the amount of goods delivered on time					
	The company increased a large number of members in supply chains					
	The company increased a number of outsourcing of the materials in various suppliers					
	The company increased corporate social responsibility activities					
	The company increased product quality					
	The company improved an effective strategy for communications in a variety of extraordinary situations					
	The company improved capacity utilisation					

Section D: *Short- and long-term impact of sustainable and resilient supply chain management*

For the following sustainable and resilient supply chain management practices (SResSCM), please indicate your perception about their level of short- (up to 0 – 3 years) and long-term (up to more than 3 years) impact as follow:

1. Sustainable and resilient supply chain management practices and short-term impact (less than three years) to your supply chain.

SResSCM practices	Short-term impact (up to 0 – 3 years)				
	No impact	Low impact	Medium impact	High impact	Extremely high impact
Eco-design					
Green production					
Social responsibility					
Investment recovery					
Collaboration					
Recovery					
External pressure					
Connectivity					

2. Sustainable and resilient supply chain management practices and long-term impact (more than three years) to your supply chain.

SResSCM practices	Long-term impact (up to more than 3years)				
	No impact	Low impact	Medium impact	High impact	Extremely high impact
Eco-design					
Green production					
Social responsibility					
Investment recovery					
Collaboration					
Recovery					
External pressure					
Connectivity					

3. Please rate the degree of company's performance in each of the following areas during responding to implement supply chain performance and sustainable and resilient supply chain management practices for short-term impact (within three years).

Company's performance	Short-term impact (up to 0 – 3 years)				
	Very low	Low	Moderate	High	Very high
Average return on investment					
Average profit					
Profit growth					
Average return on sales					
Average market share growth					
Average sales volume growth					
Average sales (in Thai Baht) growth					
Average overall competitive position					

4. Please rate the degree of company's performance in each of the following areas during responding to implement supply chain performance and sustainable and resilient supply chain management practices for long-term impact (more than three years).

Company's performance	Long-term impact (up to more than 3years)				
	Very low	Low	Moderate	High	Very high
Average return on investment					
Average profit					
Profit growth					
Average return on sales					
Average market share growth					
Average sales volume growth					
Average sales (in Thai Baht) growth					
Average overall competitive position					

Section E: *Respondent and company information*

1. What is your position within the company?

_____CEO _____Managing director
_____Supply chain director _____Logistics director
_____Supply chain manager _____Logistics manager
_____Operation manager _____Purchasing manager
_____Other, please specify_____

2. Please indicate your age category?

_____ Under 18 _____ 18 – 25 years _____ 26 – 35 years
_____ 36 – 45 years _____ 46 – 55 years _____ 56 – 65 years
_____ 66 and over

3. Please indicate your gender

_____ Male _____ Female

4. Please indicate your experience within your company?

_____ Less than 1 year _____ 1 – 3 years _____ 3 – 5 years
_____ 5 – 10 years _____ More than 10 years

5. Please indicate your experience within electronic industry?

_____ Less than 1 year _____ 1 – 3 years _____ 3 – 5 years
_____ 5 – 10 years _____ More than 10 years

6. Please indicate your company's main activity:

_____ Electronic manufacturing (OEMs)
_____ Electronic suppliers (supply for raw materials, electronics' components)
_____ Electronic distributors (support in transportation, or warehousing)
_____ Electronic wholesaler
_____ Other, please specify_____

7. How do you define your company's position in the supply chain?

4th Tier supplier	3rd Tier supplier	2nd Tier supplier	1st Tier supplier	Focal firm	1st Tier customer	2nd Tier customer	3rd Tier customer	4th Tier customer

8. What is your company's annual revenue?

_____ Less than 50 million Baht (£1 million)
_____ Between 50 million Baht to 200 million Baht (between £1 - £4 million)
_____ More than 200 million Baht (more than £4 million)
_____ Would not answer this question

9. How many people are employed in your company?

_____ Up to 50 employees
_____ 51 to 200 employees
_____ More than 200 employees

10. Where is your region company?

_____ Bangkok and Central Region
_____ North Region
_____ North East Region
_____ East Region
_____ West Region
_____ South Region

Thank you for your collaboration.

NB. If you would like to be an interviewee for the next phase of this study, please provide your information below.

_____ No
_____ Yes, Name_____
Company_____
Email_____
Telephone_____

Or if you would like to receive a copy of the research findings, it will be sent out in early 2018.

_____ No
_____ Yes, Name_____
Company_____
Email_____
Telephone_____

APPENDIX C: Structured interview protocol

To whom it may concern

My name is Worawat Joradon. I am a PhD student at the University of Hull, UK. My research theme is about sustainable and resilient supply chain management. These questions, you are holding, are a part of my research that aim to review an understanding of sustainable and resilient supply chain management in your company.

Participation in this study is voluntary. It will involve an interview of approximately one or two hours in length to take place in a mutually agreed upon location. You may decline to answer the interview questions if you wish. The data you will provide in this interview will be treated with the highest confidentiality. Your name and your company will not be identified or disclosed without the evidence of your permission.

Should you have any concerns about the conduct of this research project, please contact the Secretary, HUBS Research Ethics Committee, University of Hull, Cottingham Rd, Hull, HU6 7RX; Tel No (+44) (0)1482 463410; fax (+44) (0)1482 463689.

Thank you so much for your cooperation.

Yours truly,
Worawat Joradon
PhD student
w.joradon@2014.hull.ac.uk
Hull University Business School
University of Hull
Cottingham Rd, Hull, Yorkshire
HU6 7RX, United Kingdom

UNIVERSITY OF Hull

Dear interviewee,

This structured interview is being undertaken to review and build knowledge insights in to sustainable and resilient supply chain management based on Thai's industry. This research is directed by Dr.Claudia Colicchia and Prof.David B. Grant, and conducted by Mr.Worawat Joradon, Ph.D. student at Logistics Institute, Business School, the University of Hull, UK. All the data requested will be used for academic research purpose only and used in strict confidentially. Should you have any concerns about the conduct of this research project, please contact the Secretary, HUBS Research Ethics Committee, University of Hull, Cottingham Rd, Hull, HU6 7RX; Tel No (+44) (0)1482 463410; fax (+44) (0)1482 463689.

Section A: General background information and company's profile

Company:

_____

1. Could you please tell me about your company's background?
2. Could you please tell me about your company's primary product and product range?
3. What is your market position? Who is your main competitor?
4. How do you define your company' position in your supply chain?

4th Tier supplier	3rd Tier supplier	2nd Tier supplier	1st Tier supplier	Focal firm	1st Tier customer	2nd Tier customer	3rd Tier customer	4th Tier customer

5. Please indicate your company's main activity:

(_____) Original Equipment Manufacturer (OEMs)
(_____) Suppliers (supply for raw materials, and components)
(_____) Distributors (support in transportation, or warehousing)
(_____) Other, please
specify_____

6. Annual revenues of the company

(_____) Less than 50 million Baht
(_____) Between 50 million Baht to 200 million Baht
(_____) More than 200 million Baht
(_____) Would not answer this question

7. Size of the organization

(_____) Small firm (up to 50 employees)
(_____) Medium firm (51 to 200 employees)
(_____) Large firm (more than 200 employees)
(_____) Would not answer this question

Section B: Sustainable and resilient supply chain management practices (SResSCM) and supply chain performance in organization.

1. What do you think about the relationships between SSCM and SRES? What is the direction of the relationships? Please rate the strength of relationships from 1 to 10, with 10 being the strongest, and why?
2. In your perspective, is the understanding of SSCM/SRES/SResSCM important?
3. What do you think about the definition of SResSCM framework as " *the management of materials, information and capital flows along the supply chain with three dimensions, being environmental, economic and social perspectives by integrating resilient practices to enhance supply chain performance for different periods of time to maintain continuity of operations at the desired level of production and customer satisfaction*"?
4. Do you think that SResSCM concept can be applied in the real world/organizations' policy?
5. The survey results showed that the understanding of SResSCM definition has not a direct relationship with the implementation of SResSCM practices. What do you think? And why?
6. Do you understand about the organizations' policy in SSCM/SRES?
7. Please rate the importance of each variable of SResSCM practices from 1 to 10, which 10 being the most important, and why?

Table 1: List of SResSCM practices from the existing literature and interview in Phase 1 and survey in Phase2.

Variable's definition	Rate
The organization implements basic requirements that customers request	
The organization takes immediate action to mitigate the effects of disruptions, despite the short-term costs	
The organization follows Government/BOI legislation to conduct business using tax, or import-export criteria	
The organization can quickly provide a formal response team of key personal, both on-site and at corporate level	
The organization uses customer feedback to develop their products/productions	
The organization has a contingency plan for unforeseen disruptions	
The organization follows basic requirements of the department of labour for giving working welfare and safety for employees	
The organization's suppliers receive information about customer requirements to support the production in the company	
The organization audits their waste disposal companies to ensure it processes waste correctly	
The organization uses the policy of Board of Investment (BOI), Thailand as procedures for waste disposal	
The organization sells scrap and used materials to certified waste disposal companies	
The organization designs products that can reused and recycled	
The organization designs products that focusing on the reduction of resource consumption and waste generation in product usage	
The organization adopted environmental concerns when design their products/processes	
The organization's customers are willing to delay orders when the company's production capacity is hampered	
The organization supports or advises important information to their suppliers and customers for unforeseen disruptions	

8. Do you think that these SResSCM practices can be applied in your organization? and what practices have been applied in your organization already?
9. How sustainable supply chain management and/or supply chain resilience management can support organization performance? and supply chain performance?
10. What do you think about the relationships between SResSCM practices and SC performance? What is the direction of the relationships, i.e. Customer and operational cost (COC), Environmental cost (ENV), Business wastage (BUS), and Customer satisfaction (CS)? Please rate the strength of relationships from 1 to 10, with 10 being the strongest, and why?
11. Please rate the importance of each variable of SC performance from 1 to 10, which 10 being the most important, and why?

Table 2: List of SC performance from the existing literature and interview in Phase 1 and survey in Phase2.

SC performance	Rate
The organization improved capacity utilisation	
The organization can decrease expenses of energy consumption	
The organization can decrease expenses of materials purchasing	
The organization increased in the amount of goods delivered on time	
The organization can decrease inventory levels in their warehouse	
The organization improved an effective strategy for communications in a variety of extraordinary situations	
The organization can decrease expenses for waste discharge	
The organization can decrease effluent waste	
The organization has increased in production line	
The organization can decrease expenses for environmental accidents	
The organization can decrease the consumption for hazardous/harmful/toxic materials	
The organization increased in product quality	
The organization can decrease scrap rate	
The organization increased a number of outsourcing of the materials in various suppliers	
The organization increased a large number of members in supply chains	

12. What do you think about the relationships between SResSCM Practices and SResSCM impact? What is the direction of the relationships, i.e. Sustainable and resilient supply chain management practices impact (SRESPI), Long-term organization performance (LOP), Short-term financial (STF), and Short-term growth (STG)? Please rate the strength of relationships from 1 to 10, with 10 being the strongest, and why?
13. What is the difference between short-term and long-term impact in your understanding?
14. Do you have any suggestion for SResSCM practices from your perspective? Have I missed anything, do you have any comments/suggestions?

Section C: Interviewee information

Name: _____

Your job title/area(s) of expertise: _____

For how long have you been working in this company/industry: _____

_____

Email: _____

Contact number: _____

Note, "The data you will provide in this interview will be treated with the highest confidentiality. Your name and your company will not be identified or disclosed without the evidence of you permission".

APPENDIX D: The completed consent from

Informed Consent Letter

Research Title: Performance measurement and its impact on sustainable and resilient supply chain management practices in the Thai's industry.

Researcher: Worawat Joradon, The University of Hull, Hull University Business School – w.joradon@2014.hull.ac.uk

Purpose of the Research: This research will study about the understanding of sustainable supply chain management and supply chain resilience in the current time and develop a new framework definition of sustainable and resilient supply chain management. New sustainable and resilient supply chain management definition will assessed in a Thai context for performance measurement, short- and long-term business impacts. The results will assist company to assess their performance and develop their strategy for the future.

Output of the Research: This study is a part of PhD thesis in Hull University Business School. Companies are entitled to see and review the thesis before submission.

What You Will Be Asked to Do in the Research: If you are reading this form, you will already have received an inviting you to participate in this research. You will be asked to be involved in a brief interview – approx. 1 – 2 hours – can be face to face (I can visit companies' premises) or on the telephone.

Risks and Discomforts: I do not foresee any risks or discomfort from your participation in the research. No sensitive data will be requested and any information provided will be kept strictly confidential. Companies' information will reported anonymously and presented in aggregated form in any public outputs of the research. All gathered data will be stored in a password protected drive.

Benefits to You: This research will contribute a new framework of sustainable and resilient supply chain management and develop a measurement tool to assess short- and long-term impacts. This will be benefit to company in term of develop their strategy to make more their company sustain and resilience. The study will provide companies with a deeper understanding on how to enhance their company to achieve sustainable and resilient supply chain management goals.

Cost of the company: Null.

Voluntary Participation and Withdrawal from the Study: Your participation in the study is completely voluntary and you may decide to stop participating at any time for any reason. Your decision not to volunteer will not prejudice the nature of your relationship with the University of Hull and the Business School. In the event that you withdraw from the study, all associated data collected will be immediately destroyed wherever possible.

Confidentially: All information you provide during this research will be held in confidence. Unless you specifically indicate your consent, your and your company's name will not appear in any report or publication of the research. Your data will be safety stored on a password protected computer.

Questions About the Research? If you have questions about the research, please feel free to contact Worawat Joradon at w.joradon@2014.hull.ac.uk. Should you have any concerns about the conduct of this research project, please contact the Secretary, HUBS Research Ethics Committee, University of Hull, Cottingham Rd, Hull, HU6 7RX; Tel No (+44) (0)1482 463410; fax (+44) (0)1482 463689.

Legal Rights and Signatures:

I *(fill in your name here)* _____, consent to participate in "Performance measurement and its impact on sustainable and resilient supply chain management practices in the Thai's electronic industry" conducted by Worawat Joradon.
I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by signing this form. My signature below indicates my consent.

Please sign this form and return it to the researcher to the start of the interview.

Signature _____ **Date** _____
Participant

Signature _____ **Date** _____
Principal investigator

APPENDIX E: Email information:

Topic: Request for participation in the research
To Whom It May Concern:
Attached files are cover letter and questionnaire in this research.

I am writing to you to invite your participation in a wholly independent study supported by Business School, the University of Hull, UK and School of Business Administration, Bangkok University, Thailand. This research study is conducting research on performance measurement and its impact on sustainable and resilient supply chain management in the Thai electronic industry. Your answers will enhance measurement scale to develop sustainable and resilient supply chain management in the company.

As discussed, I have prepared a questionnaire that I will be sending out to Thai's Electronic Industry companies. I appreciate your assistance in helping me ensure that the questionnaire has no obvious errors and is sound in content and meaning. Your response will be treated in the strictest confidence and will be released only as summaries and in such a manner that no individual or company's answers can be identified.

In this email, I have attached questionnaire document within this email. You can do it in and reply to w.joradon@2014.hull.ac.uk or worawat.j@bu.ac.th. Or you can use links below for do a survey online as your preferable.

For Thai version >> http://goo.gl/forms/2wabLOHUuz

For English version >> http://goo.gl/forms/H9lrmEA2C7

Please help to complete this survey within …….. (i.e. **13th May 2016)**.

However, if you cannot participate in this survey because your position is not qualify, please help me to forward and spread out this email to person in your company as CEO or MD, and the manager as Logistics manager, Supply chain manager, Operation manager, or Purchasing manager.

Thank you very much for helping this important study.

Yours sincerely,
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APPENDIX F: Multivariate outlier

Section	Case no	D^2 Statistic	*p*-value
Sustainable and resilient supply chain management definition	6	22.39928	0.00017
	23	20.06696	0.00048
	29	29.83217	0.00001
	40	23.19531	0.00012
	41	22.39928	0.00017
	100	46.54061	0.00000
	102	27.08075	0.00002
Sustainable and resilient supply chain practices	78	58.10820	0.00012
	26	47.42944	0.00297
	77	47.33777	0.00305
	46	47.01614	0.00333
Supply chain performance	8	70.89432	0.00000
	44	76.17497	0.00000
	6	63.01242	0.00002
	78	59.12803	0.00008
	113	56.67652	0.00019
	23	55.78553	0.00025
	1	51.69282	0.00086
	68	50.28467	0.00130
	48	47.39908	0.00299
	102	46.79995	0.00354
	33	45.99611	0.00443
	77	45.65471	0.00487
Short- and long-term impact	44	75.41279	0.00002
	100	75.91195	0.00002
	56	75.94441	0.00002
	74	68.90369	0.00016
	58	68.70160	0.00017
	88	64.44861	0.00058
	68	63.78314	0.00070
	33	62.74079	0.00093
	105	62.61178	0.00097
	24	61.88232	0.00118
	8	59.48549	0.00223
	23	59.07816	0.00248
	6	58.42559	0.00294
	102	58.31988	0.00302

APPENDIX G: Univariate outlier

Section	Indicators	Case no.
Sustainable and resilient supply chain management definition	SSCM_01	6, 40, 41
	SRES_01	6, 41, 100
	SSCM_02	6, 41, 102
	SRES_02	6, 41, 56
Sustainable and resilient supply chain practices	SR_01	89
	SR_02	25, 89
	IR_01	29, 40, 46, 80, 89
	REC_01	29, 89
	REC_02	17, 25, 67, 81, 89, 105, 113
	REC_03	29, 78, 89
	EXT_01	7, 22, 25, 29, 34, 56, 80, 89
	EXT_02	25, 26, 34, 89, 91
	EXT_03	25, 56, 68, 80, 81, 89, 105
	CON_03	29, 56, 81, 89
Supply chain performance	OPT_01	7, 8, 76, 113
	OPT_02	113
	OPT_03	48, 76
	OPT_04	39, 76, 77
	BUS_01	102
	BUS_02	6
	BUS_03	6, 8, 44, 76
	BUS_04	8
	BUS_05	6, 20, 102
	ENV_01	6, 102
	ENV_02	6, 8, 68, 76, 78
	ENV_03	8, 68, 72, 76, 78
	ENV_04	32, 88, 102
	CS_01	56, 68, 76, 77
	CS_02	8, 42, 77
	CS_03	44
	CS_05	6
Short- and long-term impact	Short_09	19, 36, 67, 68
	Short_10	19, 36, 67, 68
	Short_11	4, 19, 36, 67, 68
	Short_12	19, 36
	Short_13	19, 23, 36
	Short_14	36, 44, 75
	Short_15	36, 44, 75
	Short_16	36, 75, 102
	Long_09	29, 36
	Long_10	29, 36
	Long_11	8, 29, 36, 90
	Long_12	29, 36
	Long_13	29, 36
	Long_14	29, 36, 44
	Long_15	29, 36, 44
	Long_16	29, 36

APPENDIX H: Skewness and Kurtosis for this study

Indicator	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
SSCM_01	-1.494	0.227	3.152	0.451
SRES_01	-1.296	0.227	3.724	0.451
SSCM_02	-1.533	0.227	5.372	0.451
SRES_02	-1.298	0.227	3.807	0.451
ECO_01	-0.481	0.237	-1.147	0.469
ECO_02	-0.002	0.240	-1.475	0.476
ECO_03	-0.630	0.231	-0.787	0.459
GREEN_01	-0.623	0.231	-0.714	0.459
GREEN_02	-0.686	0.231	-0.479	0.459
GREEN_03	-0.676	0.235	-0.417	0.465
SR_01	-0.779	0.230	-0.780	0.457
SR_02	-2.230	0.228	5.426	0.453
SR_03	-0.124	0.234	-1.381	0.463
IR_01	-2.036	0.235	3.079	0.465
IR_02	-1.076	0.237	-0.287	0.469
IR_03	-0.740	0.238	-1.195	0.472
COL_01	-0.559	0.235	-1.104	0.465
COL_02	-0.114	0.236	-1.634	0.467
COL_03	-0.847	0.230	-0.667	0.457
REC_01	-1.453	0.227	1.106	0.451
REC_02	-1.598	0.227	1.819	0.451
REC_03	-1.433	0.230	1.160	0.457
EXT_01	-2.019	0.227	3.390	0.451
EXT_02	-2.128	0.227	3.818	0.451
EXT_03	-1.591	0.228	1.434	0.453
CON_01	-0.901	0.229	-0.578	0.455
CON_02	-0.962	0.231	-0.492	0.459
CON_03	-1.116	0.231	-0.115	0.459
OPT_01	-0.920	0.227	1.299	0.451
OPT_02	-1.183	0.227	5.081	0.451
OPT_03	-0.494	0.227	-0.036	0.451
OPT_04	-0.614	0.227	-0.129	0.451
OPT_05	-0.317	0.227	-0.408	0.451
OPT_06	-0.529	0.227	-0.073	0.451
BUS_01	-0.456	0.227	-0.416	0.451
BUS_02	-0.409	0.227	-0.453	0.451
BUS_03	-1.102	0.227	2.304	0.451
BUS_04	-0.629	0.227	0.528	0.451
BUS_05	-0.462	0.227	-0.023	0.451
BUS_06	-0.108	0.227	-0.467	0.451
ENV_01	-0.887	0.227	2.710	0.451

ENV_02	-0.577	0.227	0.442	0.451
ENV_03	-0.546	0.227	0.138	0.451
ENV_04	-0.422	0.227	0.368	0.451
ENV_05	-0.016	0.227	-0.333	0.451
CS_01	-0.988	0.227	1.426	0.451
CS_02	-0.867	0.227	1.051	0.451
CS_03	-0.781	0.227	0.726	0.451
CS_04	-0.187	0.227	-0.367	0.451
CS_05	-0.478	0.227	-0.249	0.451
CS_06	-0.148	0.227	-0.754	0.451
CS_07	-0.069	0.227	-0.562	0.451
Short_01	0.056	0.227	-0.698	0.451
Short_02	0.175	0.227	-0.759	0.451
Short_03	0.196	0.227	-0.935	0.451
Short_04	0.131	0.227	-1.012	0.451
Short_05	0.239	0.227	-0.753	0.451
Short_06	0.203	0.227	-0.437	0.451
Short_07	0.222	0.227	-0.611	0.451
Short_08	0.106	0.227	-0.933	0.451
Long_01	-0.101	0.227	-1.064	0.451
Long_02	-0.111	0.227	-1.052	0.451
Long_03	-0.050	0.227	-1.139	0.451
Long_04	-0.149	0.227	-0.917	0.451
Long_05	0.018	0.227	-0.931	0.451
Long_06	-0.176	0.227	-0.793	0.451
Long_07	-0.144	0.227	-0.941	0.451
Long_08	-0.088	0.227	-1.160	0.451
Short_09	-0.255	0.229	0.719	0.455
Short_10	-0.233	0.229	0.615	0.455
Short_11	-0.125	0.229	0.433	0.455
Short_12	0.060	0.229	0.117	0.455
Short_13	0.081	0.229	-0.002	0.455
Short_14	-0.160	0.229	0.087	0.455
Short_15	-0.082	0.229	0.232	0.455
Short_16	-0.261	0.229	0.500	0.455
Long_09	-0.665	0.229	0.207	0.455
Long_10	-0.627	0.229	0.099	0.455
Long_11	-0.643	0.229	0.423	0.455
Long_12	-0.439	0.229	-0.164	0.455
Long_13	-0.487	0.229	0.010	0.455
Long_14	-0.606	0.229	0.209	0.455
Long_15	-0.686	0.229	0.441	0.455
Long_16	-0.721	0.229	0.605	0.455

APPENDIX I: Mann-Whitney U test results of respondents

Indicators	Mann-Whitney U test	z-scores	Sig.	Median (Early)	Median (Late)
SSCM_01	1,411.00	-0.865	0.387	4.00	4.00
SRES_01	1,527.50	-0.089	0.929	4.00	4.00
SSCM_02	1,533.00	-0.054	0.957	4.00	4.00
SRES_02	1,324.00	-1.439	0.150	4.00	4.00
ECO_01	1,306.50	-0.092	0.927	4.00	4.00
ECO_02	1,200.50	-0.375	0.708	3.00	3.00
ECO_03	1,378.00	-0.455	0.649	4.00	4.00
GREEN_01	1,382.50	-0.424	0.672	4.00	4.00
GREEN_02	1,255.00	-1.182	0.237	4.00	4.00
GREEN_03	1,249.50	-0.767	0.443	4.00	4.00
SR_01	1,318.50	-0.992	0.321	4.50	4.00
SR_02	1,391.00	-0.979	0.327	5.00	5.00
SR_03	1,174.50	-1.422	0.155	3.50	3.00
IR_01	1,290.50	-0.705	0.481	5.00	5.00
IR_02	1,225.50	-0.802	0.422	5.00	5.00
IR_03	1,266.50	-0.327	0.744	5.00	5.00
COL_01	1,238.00	-0.838	0.402	4.00	4.00
COL_02	1,095.50	-1.653	0.098	4.00	2.00
COL_03	1,428.50	-0.221	0.825	4.00	5.00
REC_01	1,430.50	-0.753	0.451	5.00	5.00
REC_02	1,426.00	-0.791	0.429	5.00	5.00
REC_03	1,383.50	-0.543	0.587	5.00	5.00
EXT_01	1,441.00	-0.738	0.461	5.00	5.00
EXT_02	1,538.00	-0.023	0.981	5.00	5.00
EXT_03	1,469.00	-0.351	0.726	5.00	5.00
CON_01	1,303.00	-1.226	0.220	5.00	4.00
CON_02	1,335.50	-0.753	0.451	5.00	4.00
CON_03	1,390.50	-0.339	0.735	5.00	5.00
OPT_01	1,526.50	-0.095	0.924	4.00	4.00
OPT_02	1,518.00	-0.155	0.877	4.00	4.00
OPT_03	1,536.50	-0.029	0.977	4.00	4.00
OPT_04	1,519.00	-0.139	0.889	4.00	4.00
OPT_05	1,503.00	-0.238	0.812	4.00	4.00
OPT_06	1,455.00	-0.545	0.586	4.00	4.00
BUS_01	1,313.00	-1.454	0.146	4.00	4.00
BUS_02	1,327.00	-1.365	0.172	4.00	4.00
BUS_03	1,371.00	-1.106	0.269	4.00	4.00
BUS_04	1,264.50	-1.747	0.081	4.00	4.00
BUS_05	1,406.00	-0.865	0.387	4.00	4.00
BUS_06	1,518.00	-0.153	0.878	4.00	4.00

ENV_01	1,350.00	-1.283	0.199	4.00	4.00
ENV_02	1,292.00	-1.632	0.103	4.00	4.00
ENV_03	1,331.50	-1.344	0.179	4.00	4.00
ENV_04	1,538.50	-0.016	0.988	4.00	4.00
ENV_05	1,346.00	-1.317	0.188	4.00	4.00
CS_01	1,445.50	-0.623	0.533	4.00	4.00
CS_02	1,526.00	-0.094	0.925	4.00	4.00
CS_03	1,466.00	-0.484	0.629	4.00	4.00
CS_04	1,522.00	-0.120	0.904	4.00	4.00
CS_05	1,458.00	-0.533	0.594	4.00	4.00
CS_06	1,518.00	-0.149	0.882	4.00	4.00
CS_07	1,506.00	-0.237	0.813	4.00	4.00
Short_01	1,454.00	-0.529	0.597	3.00	3.00
Short_02	1,399.00	-0.856	0.392	3.00	3.00
Short_03	1,443.00	-0.588	0.557	3.00	2.50
Short_04	1,407.00	-0.804	0.421	3.00	3.00
Short_05	1,351.00	-1.144	0.252	3.00	3.00
Short_06	1,453.00	-0.536	0.592	3.00	3.00
Short_07	1,354.00	-1.134	0.257	3.00	3.00
Short_08	1,461.00	-0.483	0.629	3.00	3.00
Long_01	1,480.50	-0.362	0.717	3.00	3.00
Long_02	1,472.50	-0.410	0.682	3.00	3.00
Long_03	1,448.50	-0.553	0.580	3.00	3.00
Long_04	1,489.50	-0.309	0.757	3.00	3.00
Long_05	1,469.50	-0.429	0.668	3.00	3.00
Long_06	1,512.50	-0.172	0.863	3.00	3.00
Long_07	1,460.00	-0.488	0.626	3.00	3.00
Long_08	1,528.00	-0.078	0.938	3.00	3.00
Short_09	1,387.50	-0.595	0.552	3.00	3.00
Short_10	1,406.50	-0.462	0.644	3.00	3.00
Short_11	1,374.00	-0.670	0.503	3.00	3.00
Short_12	1,304.50	-1.149	0.251	3.00	3.00
Short_13	1,291.50	-1.214	0.225	3.00	3.00
Short_14	1,329.50	-0.949	0.343	3.00	3.00
Short_15	1,347.00	-0.837	0.403	3.00	3.00
Short_16	1,320.00	-1.022	0.307	3.00	3.00
Long_09	1,389.00	-0.559	0.576	3.00	3.00
Long_10	1,436.00	-0.249	0.803	3.00	3.00
Long_11	1,450.00	-0.157	0.876	3.00	3.00
Long_12	1,468.00	-0.039	0.969	3.00	3.00
Long_13	1,379.00	-0.618	0.537	3.00	3.00
Long_14	1,318.50	-1.011	0.312	3.00	3.00
Long_15	1,282.50	-1.252	0.211	4.00	3.00
Long_16	1,381.50	-0.611	0.541	4.00	3.00

APPENDIX J: Data purification for SResSCM

Variables	Variables code	Item code	CITC	Cronbach's Alpha
SResSCM definition	SSCM definition	SSCM_01	0.751	0.850
		SSCM_02	0.751	
	SCRES definition	SRES_01	0.793	0.884
		SRES_02	0.793	
SResSCM practices	ECO-design	ECO_01	0.520	0.945
		ECO_02	0.345	
		ECO_03	0.551	
	Green Production	GREEN_01	0.680	
		GREEN_02	0.598	
		GREEN_03	0.689	
	Social responsibility	SR_01	0.769	
		SR_02	0.641	
		SR_03	0.531	
	Investment recovery	IR_01	0.713	
		IR_02	0.685	
		IR_03	0.581	
	Collaboration	COL_01	0.590	
		COL_02	0.390	
		COL_03	0.625	
	Recovery	REC_01	0.699	
		REC_02	0.803	
		REC_03	0.799	
	External pressure	EXT_01	0.737	
		EXT_02	0.641	
		EXT_03	0.731	
	Connectivity	CON_01	0.700	
		CON_02	0.681	
		CON_03	0.828	
SCM performance	Operational Cost	OPT_01	0.624	0.938
		OPT_02	0.585	
		OPT_03	0.718	
		OPT_04	0.601	
		OPT_05	0.507	
		OPT_06	0.661	
	Business Wastage	BUS_01	0.700	
		BUS_02	0.628	
		BUS_03	0.635	
		BUS_04	0.635	
		BUS_05	0.488	
		BUS_06	0.670	

	Environmental Cost	ENV_01	0.590	
		ENV_02	0.734	
		ENV_03	0.679	
		ENV_04	0.439	
		ENV_05	0.516	
	Customer Satisfaction	CS_01	0.639	
		CS_02	0.556	
		CS_03	0.548	
		CS_04	0.681	
		CS_05	0.555	
		CS_06	0.599	
		CS_07	0.602	
SResSCM short-impact	SResSCM practices	Short_01	0.658	0.923
		Short_02	0.680	
		Short_03	0.697	
		Short_04	0.775	
		Short_05	0.784	
		Short_06	0.796	
		Short_07	0.720	
		Short_08	0.742	
	Organization's performance	Short_09	0.445	
		Short_10	0.458	
		Short_11	0.516	
		Short_12	0.411	
		Short_13	0.577	
		Short_14	0.534	
		Short_15	0.613	
		Short_16	0.600	
SResSCM long-impact	SResSCM practices	Long_01	0.804	0.944
		Long_02	0.825	
		Long_03	0.818	
		Long_04	0.804	
		Long_05	0.815	
		Long_06	0.819	
		Long_07	0.766	
		Long_08	0.805	
	Organization's performance	Long_09	0.567	
		Long_10	0.589	
		Long_11	0.502	
		Long_12	0.568	
		Long_13	0.597	
		Long_14	0.629	
		Long_15	0.628	
		Long_16	0.576	

APPENDIX K: Cross loading for formative measurement model with EFA

	BUS	COC	COL	CS	ECO	ENV	IR	LOP	RP	SRESPI	SResSCM Def	STF	STG
BUS_01	**0.874**	0.503	0.182	0.431	0.218	0.561	0.259	0.077	0.394	0.182	0.311	0.085	0.239
BUS_02	**0.802**	0.525	0.128	0.475	0.266	0.439	0.304	0.104	0.375	0.110	0.343	0.159	0.340
BUS_03	**0.903**	0.616	0.198	0.495	0.321	0.589	0.251	0.245	0.444	0.217	0.331	0.176	0.318
COC_01	0.482	**0.829**	0.193	0.432	0.410	0.324	0.313	0.060	0.390	-0.011	0.180	0.290	0.230
COC_02	0.474	**0.753**	0.061	0.284	0.258	0.465	0.235	0.017	0.369	0.071	0.083	0.172	0.065
COC_03	0.424	**0.741**	0.270	0.245	0.373	0.532	0.321	0.090	0.370	0.097	0.151	0.139	0.103
COC_04	0.541	**0.829**	0.217	0.445	0.370	0.547	0.297	0.143	0.412	0.106	0.167	0.310	0.226
COC_05	0.488	**0.771**	0.126	0.420	0.400	0.435	0.269	0.182	0.324	0.161	0.218	0.332	0.271
COC_06	0.575	**0.761**	0.183	0.350	0.299	0.477	0.350	0.095	0.359	0.102	0.155	0.307	0.356
COL_01	0.158	0.187	**0.805**	0.095	0.247	0.230	0.312	0.090	0.335	-0.038	0.014	0.176	0.042
COL_02	0.184	0.203	**0.918**	0.163	0.302	0.271	0.504	0.189	0.560	-0.045	-0.072	0.282	-0.033
CS_01	0.559	0.443	0.148	**0.930**	0.278	0.499	0.180	0.229	0.214	0.080	0.279	0.417	0.368
CS_02	0.423	0.411	0.136	**0.900**	0.260	0.359	0.072	0.126	0.113	0.078	0.165	0.340	0.274
ECO_01	0.198	0.318	0.235	0.195	**0.744**	0.214	0.144	0.239	0.257	0.312	0.118	0.129	0.398
ECO_02	0.301	0.411	0.293	0.301	**0.876**	0.319	0.444	0.202	0.484	0.134	0.114	0.238	0.352
ECO_03	0.274	0.393	0.276	0.233	**0.889**	0.253	0.378	0.290	0.500	0.155	0.114	0.250	0.360
ENV_01	0.555	0.528	0.266	0.419	0.289	**0.918**	0.312	0.201	0.284	0.089	0.293	0.228	0.202
ENV_02	0.595	0.593	0.190	0.415	0.300	**0.943**	0.287	0.248	0.306	0.140	0.215	0.284	0.259
ENV_03	0.436	0.556	0.390	0.373	0.247	**0.803**	0.325	0.264	0.305	-0.006	0.013	0.409	0.149
ENV_04	0.553	0.366	0.170	0.444	0.258	**0.787**	0.160	0.248	0.300	0.110	0.226	0.186	0.328
IR_01	0.242	0.372	0.498	0.166	0.358	0.287	**0.927**	0.141	0.623	-0.079	-0.013	0.187	0.027
IR_02	0.181	0.241	0.405	0.177	0.298	0.398	**0.794**	0.127	0.515	0.036	-0.049	0.155	-0.024
IR_03	0.375	0.368	0.382	0.046	0.408	0.172	**0.889**	0.111	0.735	0.085	0.158	-0.004	0.113

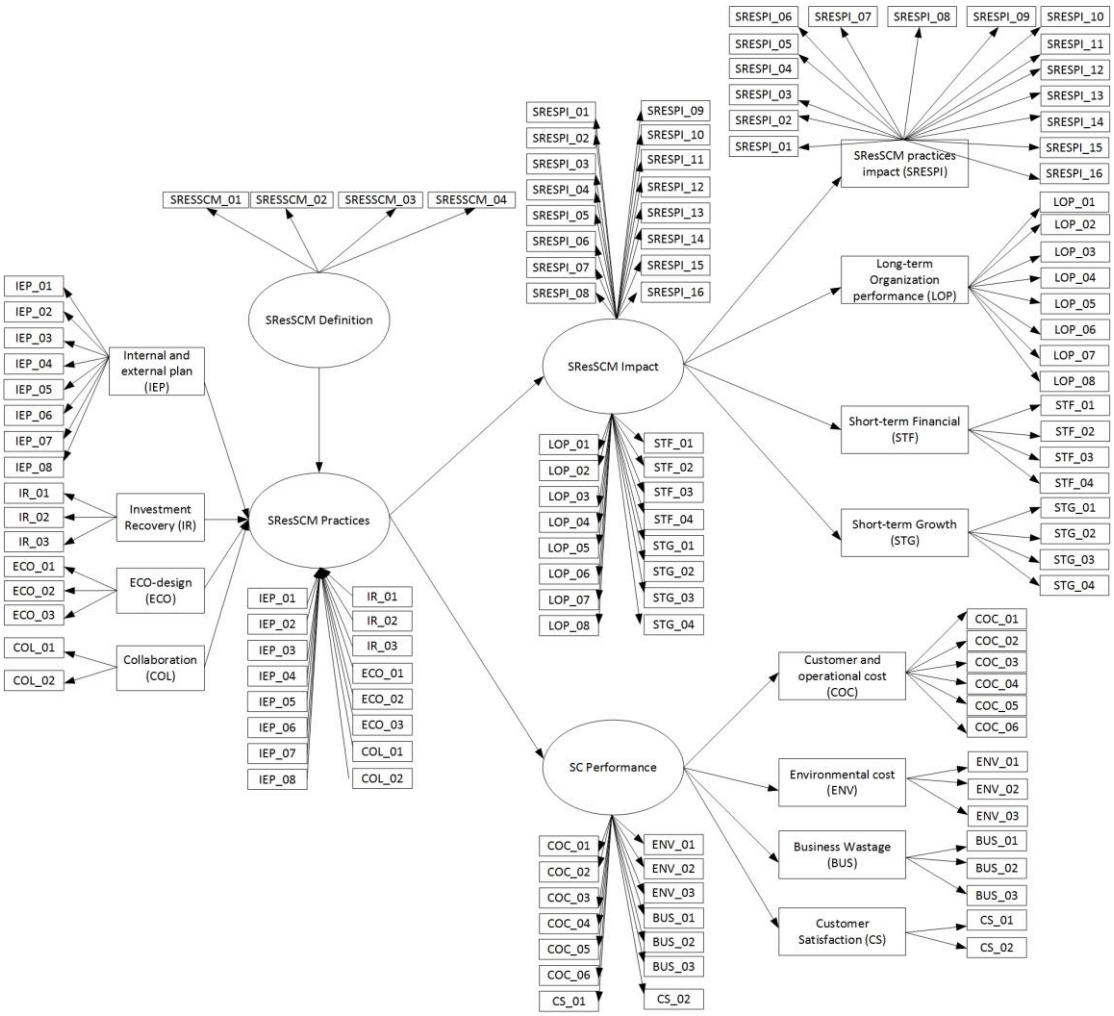
LOP_01	0.138	0.127	0.259	0.193	0.159	0.308	0.160	**0.885**	0.054	0.218	0.035	0.498	0.303
LOP_02	0.167	-0.008	0.081	0.124	0.203	0.227	0.067	**0.876**	0.033	0.348	0.331	0.234	0.434
LOP_03	0.159	0.076	0.066	0.182	0.239	0.282	0.095	**0.927**	0.083	0.357	0.234	0.341	0.461
LOP_04	0.189	0.218	0.158	0.245	0.259	0.325	0.145	**0.898**	0.100	0.299	0.061	0.562	0.440
LOP_05	0.041	0.041	0.228	0.136	0.138	0.184	0.106	**0.877**	-0.003	0.297	0.069	0.531	0.405
LOP_06	0.129	0.251	0.195	0.221	0.271	0.249	0.209	**0.855**	0.143	0.338	0.142	0.488	0.358
LOP_07	0.127	0.015	0.151	0.151	0.321	0.151	0.095	**0.924**	0.106	0.378	0.163	0.417	0.523
LOP_08	0.243	0.180	0.063	0.132	0.411	0.215	0.136	**0.735**	0.217	0.379	0.305	0.186	0.469
RP_01	0.256	0.270	0.362	0.017	0.274	0.154	0.535	0.008	**0.819**	-0.070	0.016	-0.055	0.002
RP_02	0.403	0.403	0.491	0.184	0.477	0.266	0.590	0.071	**0.903**	0.062	0.052	0.112	0.160
RP_03	0.433	0.399	0.454	0.141	0.406	0.277	0.676	0.122	**0.884**	0.011	0.088	-0.008	0.049
RP_04	0.469	0.461	0.464	0.219	0.532	0.319	0.536	0.104	**0.852**	0.144	0.090	0.026	0.092
RP_05	0.429	0.373	0.443	0.149	0.356	0.312	0.611	0.004	**0.822**	0.103	0.126	0.198	0.238
RP_06	0.464	0.453	0.517	0.163	0.496	0.443	0.678	0.189	**0.873**	0.075	0.102	0.079	0.150
RP_07	0.264	0.271	0.398	-0.042	0.315	0.140	0.604	-0.031	**0.795**	-0.022	-0.114	-0.015	-0.049
RP_08	0.440	0.552	0.493	0.370	0.587	0.385	0.663	0.208	**0.811**	0.043	0.181	0.247	0.309
SRESPI_01	0.183	0.104	-0.080	0.017	0.140	0.030	-0.081	0.335	0.007	**0.925**	0.169	0.127	0.343
SRESPI_02	0.147	0.128	-0.104	0.063	0.171	0.108	-0.047	0.309	-0.002	**0.914**	0.076	0.149	0.323
SRESPI_03	0.135	0.089	-0.087	0.031	0.236	0.098	0.012	0.275	0.066	**0.884**	0.014	0.077	0.250
SRESPI_04	0.120	0.090	-0.198	0.147	0.094	0.029	-0.072	0.276	-0.056	**0.899**	0.070	0.132	0.293
SRESPI_05	0.229	0.128	-0.109	0.074	0.177	0.035	-0.034	0.343	0.063	**0.915**	0.164	0.102	0.363
SRESPI_06	0.115	0.107	-0.055	0.089	0.113	0.095	0.003	0.345	-0.018	**0.904**	0.025	0.214	0.287
SRESPI_07	0.155	0.123	-0.031	0.111	0.150	0.000	0.044	0.307	0.114	**0.906**	0.119	0.091	0.301
SRESPI_08	0.119	0.008	0.008	0.023	0.134	0.029	-0.044	0.389	-0.008	**0.897**	0.193	0.186	0.340
SRESPI_09	0.125	0.169	-0.048	0.017	0.311	0.135	0.047	0.314	0.082	**0.888**	0.090	0.151	0.370

SRESPI_10	0.233	0.046	-0.060	0.157	0.145	0.043	0.063	0.303	0.023	**0.860**	0.198	0.150	0.365
SRESPI_11	0.163	0.117	-0.008	0.187	0.218	0.078	0.058	0.318	0.112	**0.875**	0.081	0.182	0.362
SRESPI_12	0.248	0.063	-0.073	0.043	0.201	0.108	-0.078	0.312	0.008	**0.903**	0.168	0.079	0.368
SRESPI_13	0.161	0.132	0.132	0.038	0.231	0.207	0.195	0.376	0.148	**0.841**	0.076	0.223	0.296
SRESPI_14	0.204	0.065	0.045	0.149	0.286	0.189	0.165	0.316	0.090	**0.792**	0.082	0.201	0.304
SRESPI_15	0.300	0.108	-0.158	-0.005	0.127	0.067	-0.014	0.268	0.049	**0.813**	0.191	0.079	0.350
SRESPI_16	0.176	0.103	0.142	0.071	0.289	0.128	0.039	0.457	0.081	**0.761**	0.206	0.266	0.352
SRESSCM_01	0.377	0.186	-0.056	0.209	0.140	0.246	0.073	0.198	0.088	0.122	**0.955**	0.031	0.313
SRESSCM_02	0.285	0.124	-0.015	0.236	0.091	0.146	-0.126	-0.011	0.020	0.083	**0.809**	-0.018	0.206
SRESSCM_03	0.312	0.193	-0.014	0.261	0.097	0.133	-0.003	0.145	0.058	0.134	**0.876**	-0.017	0.239
SRESSCM_04	0.322	0.065	-0.070	0.123	0.020	0.289	0.062	0.029	-0.021	0.000	**0.707**	0.102	0.291
STF_01	0.133	0.229	0.262	0.454	0.187	0.284	0.099	0.394	0.035	0.135	-0.023	**0.910**	0.538
STF_02	0.223	0.272	0.337	0.425	0.182	0.325	0.218	0.320	0.090	0.150	0.049	**0.882**	0.538
STF_03	0.182	0.397	0.158	0.369	0.279	0.282	0.037	0.419	0.100	0.210	0.019	**0.928**	0.657
STF_04	0.055	0.282	0.246	0.261	0.256	0.261	0.103	0.529	0.090	0.119	0.002	**0.866**	0.626
STG_01	0.271	0.175	-0.013	0.294	0.373	0.193	-0.008	0.475	0.094	0.349	0.271	0.642	**0.954**
STG_02	0.390	0.286	-0.047	0.340	0.317	0.267	0.033	0.468	0.109	0.274	0.248	0.605	**0.907**
STG_03	0.270	0.252	0.017	0.300	0.333	0.251	0.025	0.422	0.098	0.354	0.261	0.612	**0.907**
STG_04	0.313	0.257	0.031	0.337	0.519	0.252	0.140	0.373	0.222	0.367	0.317	0.495	**0.790**

APPENDIX L: HTMT values for discriminant validity for reflective measurement model with EFA

	BUS	COC	COL	CS	ECO	ENV	IR	LOP	RP	SRESPI	SResSCM Def	STF	STG
BUS													
COC	0.750												
COL	0.262	0.293											
CS	0.658	0.552	0.201										
ECO	0.377	0.535	0.433	0.361									
ENV	0.722	0.672	0.377	0.558	0.372								
IR	0.370	0.439	0.629	0.174	0.463	0.378							
LOP	0.195	0.168	0.208	0.221	0.333	0.305	0.163						
RP	0.529	0.519	0.646	0.225	0.563	0.374	0.805	0.136					
SRESPI	0.221	0.139	0.124	0.101	0.271	0.132	0.112	0.387	0.106				
SResSCM Def	0.438	0.197	0.077	0.276	0.133	0.261	0.121	0.158	0.104	0.125			
STF	0.193	0.365	0.343	0.485	0.282	0.357	0.178	0.494	0.125	0.180	0.068		
STG	0.404	0.305	0.059	0.411	0.521	0.304	0.103	0.521	0.176	0.400	0.336	0.718	

APPENDIX M: The first stage of the measurement model evaluation with EFA



APPENDIX N: Example of transcription from Phase One

This is an example for one of interview section that the researcher presents the transcript of first 3 pages in Thai and English, as an example.

Speaker	Thai version	English version
Researcher:	ช่วยอธิบายข้อมูลพื้นฐานหรือประวัติของบริษัทให้ฟังหน่อยครับ	Could you please tell me about your company's background?
Interviewee:	บริษัท ของเรา เป็นบริษัท ที่มาจากประเทศอเมริกา มีสำนักงานใหญ่ อยู่ที่ แคลิฟอร์เนีย ซึ่งจะทำการออกแบบ และ พัฒนาผลิตภัณฑ์ เกี่ยวกับเวเฟอร์ที่เป็นอุตสาหกรรมอิเล็กทรอนิกส์ และทำการทดสอบผลกระทบทางด้านสิ่งแวดล้อม สำหรับการทดสอบขั้นสุดท้าย ส่วนขั้นตอนการประกอบ บริษัทจะทำการส่งไปประกอบที่บริษัทอื่น แต่บริษัทจะทำการวิจัยและพัฒนาเวเฟอร์ด้วยตนเอง โดยที่บริษัทจะมีสถานที่ตั้งในหลายๆประเทศ เช่น ไทย จีน มาเลเซีย	The company is American company that there is head quarter at California. The company designs and develops wafer and test in environmental test for final test. Outsourcing operates the assembly line but the company will do R&D by themselves. There are many locations in several countries, including Thailand, China, and Malaysia.
Researcher:	สินค้าของบริษัทเป็นสินค้าประเภทใด	Could you please tell me about your product?
Interviewee:	จะแบ่งได้เป็น 2 ประเภท เป็น Control Power Management ซึ่งเป็น หัวใจหลัก ของบริษัท บริษัทแบ่งเป็น 4 BUs ใหญ่ๆ เช่น Business Consuming (Mobility), Automotive (High precision-High Quality), Industrial & Medical (High qualification), Data & Cloud. (อยู่ในพวก Analogue Power) ซึ่งบริษัทจะแบ่งเป็น Power Management (Core Business หลักๆจริงๆ)	There are two types of our product. 1) Control Power Management (Core business) is divided into 4 Bus as Business Consuming (Mobility), Automotive (High precision – High Quality), Industrial & Medical (High qualification), and Data & Cloud. And 2) Power Management that is main core business.
Researcher:	ผลิตภัณฑ์หลักของบริษัทคืออะไร	Could you please tell me about your company's primary product?
Interviewee:	บริษัททำการผลิต Integrated circuits (IC) เป็นหลัก เพราะบริษัทอยู่ในธุรกิจ Semi-Conductors ซึ่งสินค้านอกเหนือจาก IC อย่างเดียว แต่ผลิตที่ Plant ที่อื่นที่ไม่ใช่ ประเทศไทย	The primary product is Integrated circuits (IC) as Semi-conductors. However, the products are produced in plant outside Thailand, but it is sent to test in Thailand.
Researcher:	บริษัทมีพนักงานที่ทำงานเกี่ยวข้องกับ ห่วงโซ่อุปทาน (Supply Chain) มากน้อยขนาดไหน	How many people are working in supply chain or related activities?
Interviewee:	ภายในบริษัทจะเป็น เจ้าหน้าที่ทางด้านการวางแผนการผลิต ซะมากกว่า ที่จะคอยวางแผนการผลิตของโรงงานซะมากกว่า ส่วนการขนส่งจะเป็นหน้าที่ของโรงงานที่สิงคโปร์	Employees that work in supply chain activities in company are planners who plan our production in the company. The transport is normally managed by the plant from Singapore (Supply chain team).
Researcher:	ต้นทุนการจัดการ การขนส่งและการจัดการห่วงโซ่อุปทาน (Logistics and Supply Chain Management) อยู่ที่ไหน	Could you explain logistics and supply chain costs in your company?
Interviewee:	ของเสียจะเกิดมากที่สุดจาก การขนส่ง ดังนั้น ถ้ามีการบริหารที่ดี จะเกิดการประหยัดจากขนาด เพราะการจะผลิตสินค้าสำเร็จรูปของบริษัทจะต้องผ่านประมาณ 3-4 ประเทศ เพราะระยะเวลาสำหรับ ขั้นตอนการประกอบ ใช้ประมาณ 1-2 สัปดาห์ และ ทำการทดสอบ ประมาณ 1 สัปดาห์ และ ทำการขนส่งไปๆมาๆประมาณ 1-2 สัปดาห์ (เฉลี่ยอาจจะประมาณ 12 สัปดาห์)	Transportation will make more wastes in production. According to the company's production, the products are sent through 3 – 4 counties for assemble, test, and shipping to customers (approximately 12 weeks lead time). So the good management of logistics and supply chain will reduce cost for the company.
Researcher:	ท่านมีความคิดเห็นว่า การจัดการห่วงโซ่อุปทานให้ยั่งยืนคืออะไร	What is sustainable supply chain management in your understanding?

Interviewee:	คือ การจะบริหารงานในซัพพลายเชนให้ไหลลื่นได้ตลอดเวลา และต้องคาดเดาได้ เพราะการทำยังไงให้เกิดความยั่งยืน จะต้องมีการวิเคราะห์ ปัจจัยที่มีความสำคัญ ว่าส่วนใดจำเป็นที่จะต้องมีและต้องจัดการยังไงให้เกิดความเสียหายน้อยที่สุด และต้องมีการวิเคราะห์การขนส่งให้สั้นที่สุดด้วย ซึ่งเป็นเรื่อง Cost Management (เปลี่ยนไม่ได้ ลดไม่ได้ ต้องรักษาตรงส่วนนั้น) ซึ่งสิ่งที่จำเป็นของ Supply Chain ก็คือ Business Partnership ซึ่งเป็นความสัมพันธ์ ความไว้เนื้อเชื่อใจซึ่งกันและกัน และมีการเชื่อมโยงการทำงานร่วมกับSupplier/Customer/Distributor ในความคิดของผม คิดว่าการที่จะทำให้เกิดความยั่งยืนได้ไม่จำเป็นที่จะต้องจัดการอยู่ที่บริษัทอย่างเดียว สามารถกระจายการทำงานให้กับ Distributor ก็ได้ ซึ่งจะช่วยในการลดต้นทุนไปด้วย	I think sustainable supply chain management is to be administered in the supply chain to flow all the time and predictable because we need to analyse critical path to reduce damage to minimum. Moreover, the most important for the company is Supply Chain Business Partnership that needs more trust, connectivity within suppliers-manufacturer-distributors-customers. In my opinion, I believe that it is not necessary to manage sustainable supply chain management in the company alone, but we need to communicate and control with suppliers/customers to reduce investment cost.
Researcher:	บริษัทมีนโยบายการจัดการห่วงโซ่อุปทานให้ยั่งยืนหรือไม่	Does your company have sustainable policy?
Interviewee:	มี ซึ่งความยั่งยืนของบริษัทที่เกี่ยวกับห่วงโซ่อุปทาน จะเป็นกลยุทธ์ที่จะทำกับคู่ค้าซะมากกว่า ว่าใครจะสามารถทำงานร่วมกับบริษัทได้อย่างดี เป็น หน่วยธุรกิจเชิงกลยุทธ์ ของบริษัทได้หรือไม่	Yes, the company has about Sustainable supply chain strategy would be do better with Business Partner, who will work with the company for a long time. The company will monitor company's KPIs, including, Risk assessment, environmental & social responsibility, waste management, weather working climate, green company (Gold award). The company will have to increase information in corporate policy every year.
Researcher:	กิจกรรมที่ก่อให้เกิด การจัดการที่ยั่งยืน อาจจะทำให้บริษัทมีต้นทุนที่เพิ่ม ขึ้น เพราะเหตุใดบริษัทถึงยอมลงทุนที่จะทำให้บริษัทเป็น บริษัทสีเขียว (Green Company)	Does your company have an extra cost for sustainability practices? If so, why does your company invest in sustainability practices?
Interviewee:	เพราะกลุ่มที่บริษัทอยู่เป็น ลูกค้าอยู่ในกลุ่มผลิตภัณฑ์อุปโภค ซึ่งอ่อนไหวกับภาพลักษณ์ของบริษัท (อาทิ บริษัท Apple ผลิตภัณฑ์ต้องเป็น Non-lead free 100% ก็จะมีการตรวจสอบที่โรงงาน ซึ่งถ้าบริษัทยังทำตามข้อกำหนดของลูกค้ามาตลอด ก็จะยังทำธุรกิจกันต่อไป แต่หากมีข้อผิดพลาดก็อาจจะมีการยกเลิกการซื้อขายในอนาคต) และทางบริษัทมีการเซ็น MOU ร่วมกับมหาวิทยาลัยต่างๆ เพื่อให้เกิดความร่วมมือมากขึ้น	Because the company is in a group which consumer sensitive to the brand image and their production. So the company needs to achieve with customers requirement or policy that be more sustain for the future. Moreover, the company has signed a MOU with universities to achieve greater collaboration.
Researcher:	การมีนโยบายการจัดการห่วงโซ่อุปทานให้มีความยั่งยืน มีผลกระทบต่อ ซัพพลายเออร์และลูกค้าของบริษัท อย่างไร	What are the impacts to suppliers/customers when your company has sustainability policy?
Interviewee:	บริษัทจะมีการตรวจสอบไปยังซัพพลายเออร์หลัก เพื่อให้เกิดความยั่งยืน ส่วนในส่วนของลูกค้าของบริษัท บริษัทก็จะได้รับความต้องการของลูกค้ามาปรับการทำงานของบริษัทเช่นกัน	The impacts will cause to key supplier that the company needs to audit their production to be more sustain. Moreover, customers will require more process to the company, so the company needs to adapt their process following the customers.
Researcher:	นโยบายการจัดการห่วงโซ่อุปทานให้มีความยั่งยืน มีผลกระทบกับบริษัทอย่างไร	What are the impacts to your company about sustainability policy?
Interviewee:	บริษัทจะมีการแต่งตั้งกรรมการ ที่เกี่ยวกับ นโยบายการจัดการห่วงโซ่อุปทาน ให้มีความยั่งยืน แต่บริษัทก็พยายามรวมกลุ่มให้อยู่ในกลุ่มเดียวกันทั้งการทำงาน การควบคุม และการดูแล ซึ่งจะต้องทำอย่างไรให้เกิดความยั่งยืน ทั้งระบบ เพราะถ้าทุกจุด เกิดความยั่งยืนขึ้นมาแล้ว ทั้งสายก็จะยั่งยืนได้นั่นเอง	The company will have more process and procedure with committee. However, the company tries to be sustainability in each point, because if we can be sustaining each point, it means there is sustainability in a whole supply chain.

Researcher:	บริษัทมีแผนพัฒนา นโยบายการจัดการห่วงโซ่อุปทานให้มีความยั่งยืน ภายในบริษัทหรือไม่	Does your company have future plan to improve sustainability policy?
Interviewee:	มีเป็นปกติอยู่แล้ว เพราะเป็น นโยบายเชิงธุรกิจ ของบริษัท ซึ่งแผนกหลักๆก็จะมี เป้าหมายมาจากผู้บริหาร ซึ่งจะเป็นตัวกำหนดการทำงานของพนักงาน	There is usually because sustainability policy is a business policy of the company. There are goals for each department to achieve for every year.
Researcher:	การจัดการห่วงโซ่อุปทานให้มั่นคง (ยืดหยุ่น) คืออะไร	What is supply chain resilience management in your understanding?
Interviewee:	บริษัทต้องเลือก พันธมิตรทางธุรกิจ หรือคนที่ทำหน้าที่เป็น ห่วงโซ่อุปทานที่มีศักยภาพที่เหมือนกับบริษัท ต้องดูว่าซัพพลายเออร์มี ความสามารถ หรือ สถานะทางการเงิน ที่เข้มแข็งพอที่จะที่จะทำตามที่บริษัทต้องการได้ และต้องมี ความสัมพันธ์ที่ดีในระยะยาว รวมถึงซัพพลายเออร์เจ้านั้นๆ ต้องมีความเสี่ยงน้อยต่อการทำธุรกิจ บริษัทอาจจะมีซัพพลายเออร์มากกว่า หนึ่งซัพพลายเออร์ ซึ่งถือว่าเป็นการสร้างความมั่นคง เพราะอาจจะเหมือนการลดความเสี่ยงในการทำงาน รวมถึงอาจจะเป็นการที่ ซัพพลายเออร์ จะต้องอยู่กันคนละประเทศ (คนละที่ในประเทศเดียวกันก็ไม่ได้) อาจจะเรียกว่า Contingency plan ซึ่งจะหมายความว่าจะทำยังไงให้ ห่วงโซ่อุปทาน ของบริษัทจะต้องมีทางเลือกให้กับบริษัท	The resilience may be the reducing risk in the workplace. It could be the supplier, which have to live in different counties (not the same country). It might call Contingency Plan, which means it also provides alternative plan to the company. Moreover, the company will select a business partner or someone who acts like a potent supply chain company by interest in capability, financial strength, long term relationship, and low risk.
Researcher:	บริษัทมีวิธีรับมือกับปัญหาที่เกิดขึ้นอย่างไม่คาดคิดอย่างไร	How does you company control unforeseen disruptions?
Interviewee:	บริษัทจะมีการควบคุม เช่นว่า หลังน้ำท่วมจะมีการตรวจสอบระดับน้ำทะเล ร่วมกับระดับน้ำในนิคม รวมถึงการรับฟังข้อมูลข่าวสารจากรัฐบาล มาใช้ในการบริหารงานในช่วงวิกฤต จะมีการเคลื่อนย้ายวัตถุดิบ เพื่อย้ายไปทำการผลิตที่ฐานการผลิตอื่นที่ปลอดภัย และทำการผลิตเพื่อสนับสนุนความต้องการของลูกค้า โดยจะทำการสรุปว่าลูกค้าไหมมีความสำคัญ และต้องทำการจัดส่งให้ได้ตามต้องการมากที่สุด และเมื่อเกิดเหตุประสบภัยในอดีต บริษัทก็จะมีการวางแผนใหม่ (มีประสบการณ์) เพื่อดูเหตุการณ์ที่อาจจะเป็นไปได้ในอนาคต และทำการวางแผนว่าจะรับมืออย่างไร เลเวลของการเกิดเหตุการณ์จะแบ่งเป็น ต่ำ-กลาง-สูง และการจัดการก็จะเป็นไปตาม ต่ำ-กลาง-สูง ซึ่งจะมีการรับมือ การจัดการที่แตกต่างกัน บริษัทเลยมีการกระจายความเสี่ยง (Risk mitigation)	The company will monitor the process and analyze the impact from disruption. Then, management team will determine suitable plan for the company and inform their strategy to our customers. After that disruption happened, the company will review their plan and prepare an appropriate plan for the future.
Researcher:	ซัพพลายเออร์ได้รับ ผลกระทบจาก การจัดการห่วงโซ่อุปทานให้มั่นคง ของบริษัทหรือไม่	Is supply chain resilience management policy impact to your suppliers/customers?
Interviewee:	มีผลกระทบแน่นอน เพราะ ซัพพลายเออร์ จะต้องมี การเก็บวัตถุดิบที่มากขึ้น (ปกติเรียก Kanban) สำหรับ วัตถุดิบสำหรับสินค้าของบริษัท และจะต้องมี แผนสำหรับสภาวะฉุกเฉิน ให้กับทางบริษัทด้วย รวมถึงจะมีการสนับสนุน การทำงานจากบริษัทให้กับซัพพลายเออร์เพื่อที่จะพัฒนาซัพพลายเออร์ ให้มีความสามารถเพียงพอ กับการทำงานของบริษัท ซึ่งบริษัทมองว่าการพัฒนาซัพพลายเออร์ ถือว่าเป็นการลงทุนอย่างหนึ่ง เหมือนกับการลดความเสี่ยงของบริษัท ถ้าบริษัทลดความเสี่ยงได้ ความเสียหายที่เกิดจากซัพพลายเออร์ก็จะลดลงไปด้วยนั่นเอง	Yes, suppliers will need to have more inventory buffer (called Kanban) for the company and also they need to provide contingency plan to the company. However, the company needs to support suppliers to improve their capable and performance in the future. The company believes that if the company can reduce risk, the damage caused by the suppliers will decrease with it.

Researcher:	บริษัทมี เป้าหมาย เกี่ยวกับ การจัดการห่วงโซ่อุปทานให้มีความยั่งยืน และ มั่นคง หรือไม่	Does your company have goals for sustainable and resilient supply chain management?
Interviewee:	อาจจะบอกได้ว่าบริษัทจะมี เป้าหมายทางด้าน สิ่งแวดล้อม มากกว่าด้านอื่นๆ	The company has goals in environmental more than others.
Researcher:	เมื่อบริษัทมีการออก นโยบายใหม่ๆออกมา บริษัทประสบปัญหาอย่างไร	What are the problems that are found in implementing sustainable and resilient supply chain management practices?
Interviewee:	ระดับผู้จัดการ จะต้องอธิบาย ระดับผู้บริหาร ให้ได้ว่าจะสามารถปฏิบัติได้เมื่อไหร่ แล้วปัญหาที่เกิดขึ้นเกิดจากอะไร ซึ่งทาง ผู้จัดการจะต้องสามารถอธิบายให้ได้ ส่วนพนักงานก็จะต้องปฏิบัติตามนโยบาย ของบริษัทที่ ทางกลุ่มผู้บริหารได้แจ้งมา	Managers will have to explain to management team about the lead-time to achieve sustainable and resilience policy. Moreover, managers need to explain to employees to follow with the policy but it is difficult to do that because it might make more process in production and employees do not want to follow.
Researcher:	ในความคิดเห็นของท่าน ท่านคิดว่า การจัดการห่วงโซ่อุปทานให้ยั่งยืน กับ การจัดการห่วงโซ่อุปทานให้มั่นคง มีความสัมพันธ์กันหรือไม่	In your opinion, do you think that sustainable supply chain management and supply chain resilience management are related together?
Interviewee:	มีแน่นอน อาจจะเป็นความสัมพันธ์ต่อเนื่องกัน ต้องมีความสัมพันธ์ระหว่าง ก่อนบริษัท หลังบริษัท รวมทั้งหมดอาจจะ 3 ระดับ ซึ่งต้องมีการให้ความช่วยเหลือซึ่งกันและกัน อยู่ในสายอุปทานเดียวกันทั้งหมด ต้องเป็นทั้ง ความยั่งยืน และจำเป็นที่จะต้องมีความมั่นคงซึ่งถ้าสายอุปทานเของบริษัทขาด ความยั่งยืน และ ความมั่นคง ก็จะขาดออกไปด้วย	There may indeed be a relationship together. However, there need to have the relationship between suppliers-manufacturer-customers or supply chain, and it needs to have sustainable and resilience together.
Researcher:	บริษัทมีแผนที่จะพัฒนา การจัดการห่วงโซ่อุปทานให้มีความยั่งยืน และ มั่นคง ในอนาคตหรือไม่	Does your company further improved sustainable and resilient supply chain management policy?
Interviewee:	จะเป็นการปฏิบัติงานมากกว่าจะเป็นนโยบาย ซึ่งจะช่วยกันพัฒนา การจัดการห่วงโซ่อุปทาน ให้มีความยั่งยืน และ มั่นคง ซึ่งแต่ละแผนกจะมีหน้าที่ที่แตกต่างกันออกไป แต่ก็จะเกี่ยวข้องกับ ความยั่งยืน และ ความมั่นคง ของบริษัท ซึ่งถ้าทุกแผนกทำตามข้อปฏิบัติ ก็เชื่อว่าจะสามารถทำให้บริษัทมี การจัดการห่วงโซ่อุปทานให้มีความยั่งยืนและมั่นคงที่ดีได้	The company has job functional as a policy. So each department will has different role for sustainable and resilient supply chain management but they need to be achieved to improve the company more sustainable and resilience.
Researcher:	บริษัทมีการตรวจสอบแผนของซัพพลายเออร์หรือไม่	How do you ensure that your suppliers/customers are following the same line of sustainable and resilient policy?
Interviewee:	จะมีการ ตรวจสอบซัพพลายเออร์ ทุกปีตาม check list เช่น ระดับผู้บริหาร เป็นอย่างไง คุณภาพของสินค้าเป็นอย่างไร เขาเป็นยังไง การบริการของซัพพลายเออร์เป็นอย่างไร กลุ่มธุรกิจของซัพพลายเออร์เป็นยังไง ซึ่งอาจจะมีเพิ่มเติม เช่น กฎหมายแรงงาน ซึ่งบางครั้ง ซัพพลายเออร์ไม่สามารถปฏิบัติตามข้อกำหนดของบริษัทได้ตลอด บริษัทก็จะมีการตักเตือน และตรวจสอบย้อนกลับอีกครั้งเพื่อให้เกิดการพัฒนาที่ยั่งยืนมากกว่า	The company has suppliers audit to assess supplier's plan. There are check lists about quality management, service system for supply chain, and Labour laws. Some suppliers cannot maintain procedures throughout the company so the company needs to feedback and support suppliers to ahcieve a more sustainable and resilient developement.