Antecedents and Consequences of Supply chain innovation: Empirical evidence from Vietnamese agricultural supply chain

by **Phi Yen Phan**

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Doctor of philosophy

under the supervision of:
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ABSTRACT

Many firms today are striving to adopt innovations for their survival and competitiveness. As a large part of a firm‘s innovation capability resides in its external relationships, innovation is increasingly seen as a collaborative process that involves the participation of various stakeholders in the supply chain. This gives rise to the notion of Supply chain innovation (SCI). In the context of agriculture, the role of SCI has become increasingly important due to growing global demand for food and an increased consumer focus on food quality, traceability and safety. As evident from extant literature, there has been a lack of empirical investigation of SCI as a capability, including its antecedents and consequences, which are highly relevant to and vital for an effective SCI adoption. Relevant past research has been found to focus on a particular type of innovation, such as a product, process or technological innovation, in the context of an individual firm or a binary relationship. Consequently, drawing on Transaction cost theory (TCT) and Dynamic capability theory (DCT), this study aims to: (1) explore the critical antecedents of SCI, including Contract, Trust, Supply chain collaboration (SCC) and Supply chain learning (SCL); (2) investigate the influence of SCI on supply chain performance (SCP), which is moderated by Environmental uncertainties (ENU). This study is conducted based on a mixed methods design, comprising case studies (phase 1) and a survey (phase 2), with empirical evidence from Vietnamese agricultural supply chains.

The results of four exploratory case studies not only provided preliminary support, but also enriched the theoretical model by suggesting an important impact of Awareness on SCI, which has been unexplored in the current literature. The enriched model was then empirically tested, based on a survey of 318 actors in the rice and coffee supply chains in Vietnam, using different analytical methods including Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA) and Structure Equation Modelling (SEM). The quantitative results reveal four main findings. First, Contract, Trust, SCL and Awareness are all positively associated with SCI. Second, SCC partially mediates the effects of both Contract and Trust on SCI. Third, SCI has positive impacts on SCP. Last, while demand uncertainties have an adverse effect on the SCI-SCP nexus, technology uncertainties have no statistically significant effect.

The findings of this study are significant in terms of theoretical, methodological and practical contributions, as well as policy implications. Initially, this study provides the

first systematic review of relevant research on the antecedents and consequences of SCI, to produce an integrated and multi-dimensional framework for these constructs as applicable to an agricultural SC. More importantly, this study extends and makes novel contributions to TCT and DCT, based on the first and only investigation of: (1) the mediating role of SCC in the effect of Contract and Trust on SCI; (2) the impact of Awareness and SCL on SCI, which has been unexplored in the current literature; (3) the influence of SCI on SCP moderated by ENU. Furthermore, the investigation of SCI – covering different types of innovation collectively, and involving multiple functions in the supply chain within the distinctive context of Vietnam‘s agriculture supply chain – makes this study unique. Of practical application, by establishing the consequences of SCI, this study‘s findings can stimulate SCI implementation and sucess. The study has managerial implications for supply chain/innovation managers and their like. As managers acknowledge the critical determinants of SCI, they will be able to manage their business operations and supply chain activities in an effective and efficient manner, instrumental in SCI. This study also offers some implications for policymakers in Vietnam. Lastly, from a methodological perspective, this study demonstrates the effectiveness of mixed methods research based on a combined case study and survey approach, which has rarely been undertaken in this research area.

CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Phi Yen Phan, student ID – [redacted], declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Business School at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

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Phi Yen Phan

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"I was always busy through the day;

I didn't have much time to play.

The little games you asked me to –

I didn't have much time for you.

I'd go to work, study and cook.

But when you'dbring your picture book.

And ask me to share your fun.

I'd say: "a little later son".

I will always be there for you, no matter what, and you will always be my number one. I wish you all the good things that life can offer you. Mommy loves you to the moon and back!

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List of Acronyms

ACSCMP	American Council of Supply Chain Management Professionals
AMOS	Analysis of Moment Structure
ASV	Average Shared Variance (ASV
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CR	Composite reliability
DC	Dynamic Capability
DCT	Dynamic capability theory
df	Degrees of Freedom
EFA	Exploratory Factor Analysis
ENU	Environmental uncertainties
ERC	Efficient Consumer Response
ERP	Enterprise Resource Planning
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GFI	Goodness-of-fit Index
HOELTER	Hoelter‘s index
IT	Information technology
KBV	Knowledge-Based View
KMO	Kaiser-Meyer-Olkin
ML	Maximum Likelihood
MSV	Maximum Shared Variance
NFI	Normed Fit Index
OECD	The Organisation for Economic Co-operation and Development
RBV	Resource-Based View
RDT	Resource Dependence Theory
RFID	Radio Frequency Identification Device
RMSEA	Root Mean Square Error Approximation
SC	Supply Chain
SCC	Supply Chain Collaboration
SCI	Supply Chain Innovation
SCL	Supply Chain Learning
SCM	Supply Chain Management
SCP	Supply Chain Performance
SEM	Structure Equation Modelling
SET	Social Exchange Theory
SMI	Supplier Managed Inventory
SPSS	Statistic Packages for Social Sciences
SRI	System of Rice Intensification
SRP	Sustainable Rice Platform
TCT	Transaction Cost Theory
TLI	Tucker-Lewis Index
VMI	Vendors Managed Inventory

Chapter 1: INTRODUCTION

1.1 Background to the research

Many firms today are striving to adopt innovative practices that are considered vital for competitive advantage, value creation and, ultimately, firm survival (Berghman et al., 2013; Fagerberg et al., 2005; Hoover Jr et al., 1996; Hult et al., 2004; Porter, 1990). The Organisation for Economic Co-operation and Development (OECD, 2000) has provided a commonly used definition of innovation, namely, the implementation of significantly improved or new products and processes, marketing methods and organisational methods in workplace organisation, business practices or external relations. Organisations typically focus internally and mostly leverage their internal capabilities, whereas a large part of an organisation‘s innovation capability also resides in its external relationship network (Bessant et al., 2012). Going beyond organisational boundaries with customers and suppliers is an important source of value creation (Bowersox et al., 2000; Chesbrough et al., 2006; Parker, 2000). The focus of innovation has therefore shifted from intra- to inter-organisational relationships and, more so, to supply chains or value networks (Agarwal & Selen, 2013; Ageron et al., 2013; Bello et al., 2004). This gives rise to the notion of supply chain innovation (SCI).

SCI has previously been applied to various areas in supply chain management (SCM), such as supply chain business process optimisation (e.g. Bello et al., 2004; Holmström, 2000), logistics excellence (e.g. Jayaraman & Luo, 2007; Little, 2007) and supply chain technology implementation (e.g. D. B. L. Santos & L. S. Smith, 2008; Wu & Chuang, 2010). Recently, a comprehensive definition of SCI was proposed by (Gao et al., 2017), based on their systematic literature review, as: ―*an integrated change from incremental to radical changes in product, process, marketing, technology, resource and/or organisation, which are associated with all related parties, covering all related functions in supply chain and creating value for all stakeholders*" (Gao et al., 2017, p. 1530). SCI has become a more popular research topic over the past few years (Gao et al., 2017; Jajja et al., 2019). Specifically, research on SCI antecedents has been identified as an emerging theme in the extant literature (Gao et al., 2017). SCI has also been widely accepted as an imperative instrument for improving firm and/or supply chain performance (e.g., El-Kassar & Singh, 2019; Kim & Chai, 2017; Piening & Salge, 2015).

Noting that, in recent decades, agricultural supply chains have become increasingly important due to factors such as increased global food demand (expected to rise by 77 per cent by 2050) (FAO, 2012) and increased consumer concern about food quality and safety (Gebresenbet & Bosona, 2012). In addition, recent trends such as increased regulatory complexity, globalisation of marketing and just-in-time delivery systems can pose challenges for the optimal performance of supply chains (Gebresenbet & Bosona, 2012). Meanwhile, agriculture supply chains have faced multiple challenging issues, such as the short shelf life of raw materials, the long lead time for producing agricultural products, seasonality in production and demand, inefficient processes, and high losses occurring at every stage in the supply chain (Cagliano et al., 2016; Van der Vorst et al., 2007). All of these factors clearly demonstrate a pressing need for innovations within agricultural supply chains, enabling them to become more efficient, agile, resilient and sustainable (Gualandris & Kalchschmidt, 2014; Kwak et al., 2018; Lee et al., 2011).

To this end, the area of focus of this study is SCI in agricultural supply chains. The research area is delineated as Figure 1.1.

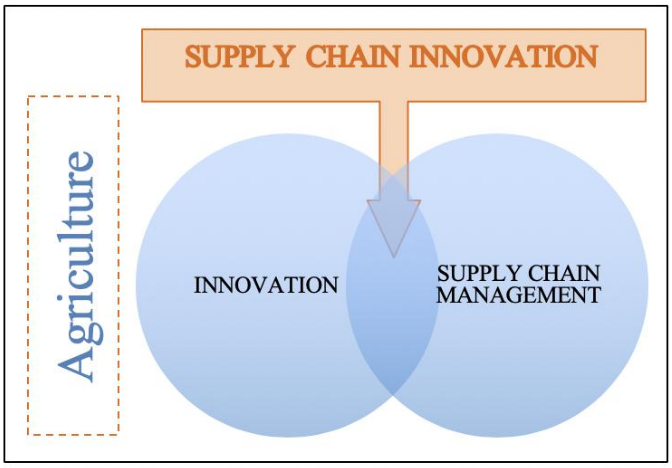

Figure 1.1: Delineating the research area

1.2 Motivation for the research

Although innovation has gained increasing attention in the literature, there seems to be less emphasis on innovation in the supply chain context (Arlbjørn et al., 2011; Gao et al., 2017). This is especially true for the theme of antecedents and consequences of innovation, with most of the previous research conducted in the context of a focal firm and/or its interaction with suppliers/customers (e.g., Golgeci & Y. Ponomarov, 2013; Kim & Chai, 2017; Krolikowski & Yuan, 2017; Salunke et al., 2011). Several studies linked innovation to supply chain, yet most of these focused only on a particular type of innovation, such as a product, process or technological innovation (e.g., Jajja et al., 2014; Ju et al., 2016; Lee et al., 2014; Sabri et al., 2018; G. C. Wu, 2013). This denotes a strong need for investigations of SCI that cover all related functions and involve all related stakeholders in the supply chain, according with the comprehensive definition of SCI proposed by Gao et al. (2017).

In addition, although a large number of studies have explored the antecedents of SCI, the relevant literature is relatively diverse and wide-ranging. There has also been a lack of consensus on some factors, with inconsistent conclusions presented in the literature (e.g., on the impact of Trust and Contracts on innovation), not to mention that other factors have been less studied or unexplored, such as SCL and Awareness (see Chapter 2, Section 2.5.2). This signals a need for re-assessment of these studied factors, or further examination of the areas gaining less attention in the literature. Regarding the consequences of SCI, most prior research has centred on the impact of innovation in terms of a firm‘s performance (e.g., Chinomona & Omoruyi, 2016; Grawe et al., 2009; Ho et al., 2018; Jean et al., 2012; Nguyen & Harrison, 2019). Thus, there has been a scarcity of research linking innovation with the performance of an entire supply chain. All of the above issues motivate this study.

On the other hand, whereas a mass of related literature focuses on manufacturing and service context, very little research has been conducted in the agricultural context, which has a strong need for innovations, as indicated earlier. It should be noted that the agriculture sector plays an important role in the economy of many countries. Specifically, agriculture is one of the most important economic sectors in Vietnam, accounting for almost 15% of the country‘s GDP (GSO, 2020). The sector is also a key source of Vietnam‘s employment, with almost half of the population involved in agricultural activities (MARD, 2020). However, Vietnam‘s agriculture, especially its horticultural supply chains, has been shown to have a number of shortcomings, such as fragmented production, inefficient processes and high losses (waste) occurring at every stage of the supply chains (OECD, 2015; Pham et al., 2017; World Bank Group, 2016). This leads to the poor performance of the supply chains, the relatively poor competitiveness of Vietnamese agricultural products and the low income of Vietnamese farmers. Among the country‘s various agricultural products, rice and coffee can be viewed as typical supply chains that manifest these identified issues, despite these products being primary commodities and leading export products (Do, 2017; Hung Anh & Bokelmann, 2019; MARD, 2020; Nguyen & Mai, 2017; World Bank Group, 2016). This, again, clearly indicates a strong need to adopt innovations to improve agricultural supply chains in Vietnam, so that all of these existing problems can be addressed and improved. This need also motivates this study.

There is, therefore, a major gap in the literature, and a pressing need to empirically investigate the antecedents and consequences of a *„comprehensive"* SCI, especially in agricultural supply chains. In addition, the distinctive characteristics of Vietnam‘s agricultural supply chains (see Chapter 2, Section 2.4.2) will make the investigation of this research topic novel in the context of Vietnam‘s agriculture.

1.3 Research objectives and research questions

In light of the shortcomings of the extant literature, this study aims to explore and examine the impact of critical antecedents on SCI; and investigate the outcomes of SCI, as well as possible mediators and moderators of the proposed relationships in the context of agricultural supply chains in Vietnam.

Based on the findings obtained from the systematic literature review conducted in this study, critical factors that have been unexplored or less studied, or those resulting in a lack of consensus in previous research, were considered. These factors include Contract, Trust, Supply chain collaboration (SCC), Supply chain learning (SCL), Supply chain performance (SCP) and Environmental uncertainties (ENU). Apart from being based on the identified gaps and relevant literature, the selection of these factors was also affected by the context of Vietnam‘s agricultural supply chains, in which the importance of effective governance, learning mechanisms and collaboration across the chain for the effectiveness and success of innovation in the supply chain is clear.

Drawing on Transaction cost theory (TCT) and Dynamic capability theory (DCT), this study seeks to explore: (1) the role of Contract, Trust, SCC, and SCL on SCI, wherein SCC mediates the impacts of Contract and Trust on SCI; (2) the impact of SCI on SCP; and (3) the moderating role of ENU, to examine the relationship between SCI and SCP. The research questions to be answered in this study are:

(1) How do Contract and Trust individually affect SCI?
(2) How does SCC affect SCI? Does it mediate the impacts of Contract and

Trust on SCI?

(3) How does SCL affect SCI?

(4) How does SCI impact on SCP?

(5) How do environmental uncertainties moderate the relationship between SCI and SCP?

1.4 Research methodology and research design

This study employed a mixed methods research approach based on a two-phase exploratory design, with emphasis on the quantitative element. The mixed methods approach was selected for several reasons: (1) the nature of the research problem – SCI, which is an emerging phenomenon, (2) the context of this research – agricultural supply chains in Vietnam, where no research has been found that explores this research problem, and (3) the assurance of research reliability and validity.

Due to the research topic being contemporary, an exploratory design was employed, and includes two phases. In phase one, qualitative research using a case study-based approach was used for: (1) obtaining a deeper understanding of the research problem in a real-life context of Vietnamese agriculture, (2) preliminary testing and validating of the survey instrument and the conceptual model, (3) enriching the conceptual model and measurements by identifying new variables or hypotheses (where possible). Direct semi-structured interviews were applied for data collection in four case studies. In phase two, the predominant quantitative study was utilised for testing the survey instrument and the hypotheses. The survey method, using structured questionnaires and face-to-face surveys, was based on a large sample size of 318 respondents. The quantitative data analysis employed multiple analytical methods: Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and Structural Equation Modelling (SEM) with the help of SPPS and AMOS software.

As this study focuses on rice and coffee supply chains, the research sites of both the qualitative and quantitative phases encompassed three main regions: the Mekong Delta, the Central Highlands and the Southeast, which are major rice- and coffee-producing areas in Vietnam. The respondents are supply chain/operations/purchasing managers, directors of participating companies, and farmers/farm owners.

1.5 The contributions of this study

The study firstly contributes to improved knowledge of SCI, by providing the first holistic depiction of it as a unified and multi-level framework of antecedents and consequences, synthesising relevant past studies in the extant literature. This is useful for academics, since it reveals work to date in the literature and identifying research trends in the area. Simultaneously, the findings will benefit innovation and/or supply chain practitioners, helping them to achieve better understanding and decision-making in relation to the influential factors and outcomes of SCI.

More importantly, being the first and only investigation of the critical antecedents and consequences of SCI in an integrated framework based on agricultural supply chains, this study makes significant theoretical, methodological and practical contributions, as well as delivering policy implications. These contributions are detailed as follows:

Theoretically, the findings of this study have extended and made novel contributions to TCE and DCT, which were used as theoretical grounding for the proposed relationships in the research model. In particular, the study uniquely examines the mediating role of SCC in the impact of Contract and Trust on SCI. It provides the first investigation of the effect of Awareness and SCL on SCI, which has been unexplored in SCI literature. This study is also the first to explore the influence of SCI on SCP, moderated by ENU. Futhermore, the investigation of a comprehensive SCI, covering multiple types of innovation collectively and involving multiple stakeholders in the agricultural supply chain, is also novel.

From a methodological perspective, the study could be used as a blueprint for future work, grounded in the approach of a systematic literature review based on content analysis with step-by-step directions, and on a rigorous mixed methods research involving a combined case study and survey approach, which has rarely been found in this research area.

As for practical implications, by establishing important antecedents and outcomes of SCI, the findings will help to stimulate SCI implementation and success, leading to an overall improved SCP. The study has some managerial implications for supply chain/innovation practitioners and their like. First, the findings will help managers to acknowledge the critical influential factors of SCI, thereby enabling them to effectively manage their business operations and supply chain activities, as well as innovative practices, which are instrumental in SCI. Second, the findings will help to identify the likely significant impacts of SCI on SCP, which will inform managers in not only adopting but also developing SCI innovations. Last, the findings will provide an understanding of the effects of ENU on the SCI-SCP link, helping managers to develop strategies for dealing with ENU in a way that maximises the effectiveness of SCI implementation.

This study also offers implications for policymakers in Vietnam, helping them to improve collaboration, learning and awareness of innovations across the agricultural supply chain, in turn promoting the adoption and success of innovations in the supply chain, and then improving the overall performance of the chain.

1.6 Organisation of the thesis

This thesis comprises seven chapters. The introduction chapter first presents the research background and motivation for the research, along with the research objectives and questions. This chapter also provides a summary of the research methodology and contributions, and the outline of the thesis at the end. Chapter 2 provides an intensive literature review on various aspects, including: a review of key concepts such as supply chain, innovation and supply chain innovation; an analysis of agriculture supply chains; a systematic literature review of the research topic; and lastly, a review of the critical factors, which are the constructs of the research model. Chapter 3 contains the theoretical grounding and hypotheses development of the study. Chapter 4 presents all details and procedures related to the research methodology and process, such as the research method, research design, and data collection and analysis for both the qualitative and quantitative phases. The qualitative and quantitative findings are presented in Chapter 5 and Chapter 6, respectively. Chapter 7 concludes this thesis with a discussion on the research findings, followed by the contributions and limitations of the study, as well as recommendations for future research. The information flow and key contents of each chapter are illustrated as Figure 1.2.

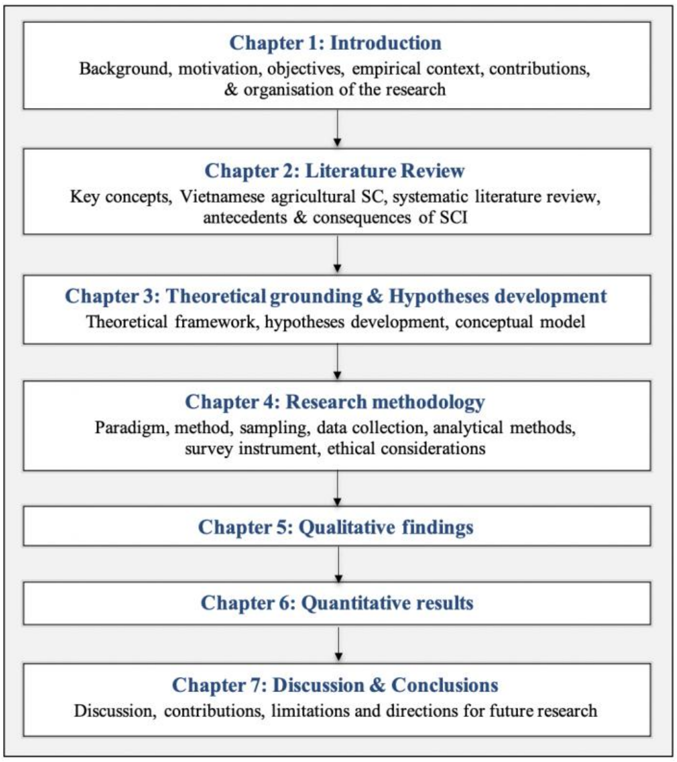

Figure 1.2: Organisation of the thesis

Chapter 2: LITERATURE REVIEW

2.1 Introduction

The literature review chapter firstly defines key concepts, including supply chain, supply chain management, innovation and SCI, in Section 2.2 and Section 2.3. The review then provides an analysis of agricultural supply chains, and specifically the rice and coffee supply chains in Vietnam, which is the empirical context of this research (Section 2.4). After that, it presents a systematic review of related previous research, underlining the review process, analysis method and findings (Section 2.5). Section 2.6 then provides a review of the critical antecedents and consequences of SCI, which are the potential constructs of the conceptual model. The chapter concludes with a summary of the identified gaps, and explains how this study addresses these gaps. Figure 2.1 diagrammatically represents the structure of this chapter.

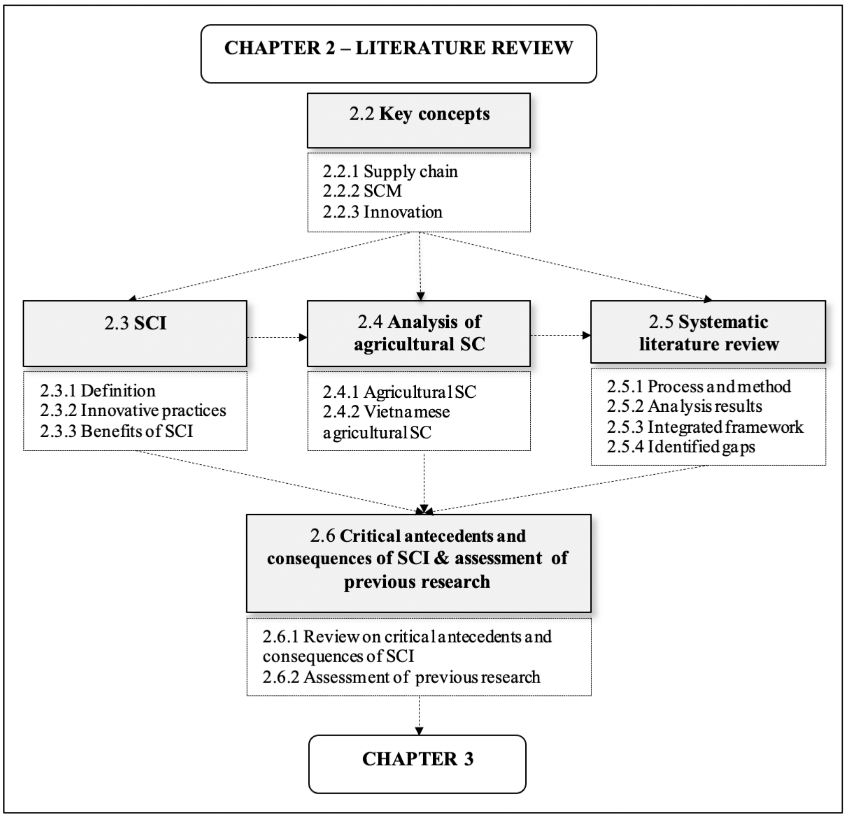

Figure 2.1: The outline of chapter 2

2.2 Key concepts

2.2.1 Supply chain

While introduced by some specialists in the 1980s, the term ‗supply chain' has been widely used since the 1990s, together with the corresponding notion known as supply chain management (SCM) (Stock et al., 2010). There have been numerous common definitions of supply chain in the literature. In this study, some common and well established definitions of supply chain are presented to capture different perspectives of the supply chain (i.e., the entities of the supply chain, stream of materials, flows of products/services etc.) as well as to show the evolution of the concept over time (i.e., earlier to more recent definitions). In one early concept, it was defined as a set of independent organisations involved in producing products and bringing them to final consumers (La Londe & Masters, 1994). Subsequent definitions focused on the stream of materials or goods from initial supply to final consumption. For instance, according to Mentzer et al. (2001, p. 4), supply chain is ―a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances and/or information from a source to a customer". Similarly, Waters (2009) states that a supply chain includes a series of firms and activities through which materials travel from the source of initial suppliers to ultimate consumers. In other words, a supply chain comprises all parties directly or indirectly involved in fulfilling customers' requests, normally including material suppliers, manufacturers, distributors or wholesalers, retailers and final customers (Chopra & Peter, 2013).

Shukla (2004) proposed the three distinct stages of a supply chain. First, inbound supply chain refers to value addition to raw materials, such as selection, storing and transportation. Second, internal supply chain ensures value addition during the production/manufacturing of products. Last, outbound supply chain involves distribution operations such as transportation and inventory management. In a broader sense, a supply chain includes all functions involved in receiving and filling customer requests, including new product development, operation, marketing, distribution, customer service and finance (Van der Vorst et al., 2007).

The nature of a supply chain is related not only to material flows or dyadic relationships; it should be viewed from a network perspective (Borgatti & Li, 2009).

From this point of view, Christopher (2011) defines supply chain as a network of firms upstream and downstream that are linked and involved in various processes and activities to create value in the form of products/services and bring them to end-consumers. Van der Vorst et al. (2007) also look at supply chain within the context of a ‗total supply chain network', as depicted in Figure 2.2. In such a network, each organisation belongs to at least one supply chain and usually has multiple customers and suppliers. For example, a producer can obtain raw materials from different suppliers and deliver their products to many processors, who in turn distribute the processed product to one or more retailers.

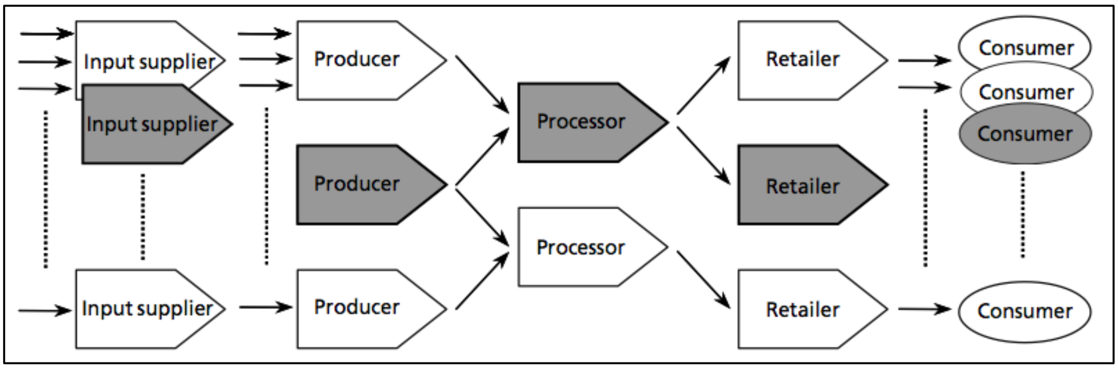

Figure 2.2: A generic supply chain within the total supply chain network (Van der Vorst et al., 2007)

2.2.2 Supply chain management

There are various ways to approach the Supply chain management (SCM) concept in the literature. Some researchers see SCM in terms of operations associated with the flow of materials or products, while others define it as management processes (Mentzer et al., 2001). For example, Umeda and Jones (1998) defined SCM as "the management of material and information flows both in and between facilities in the chain, such as vendors, manufacturing plants, and distribution centres". According to Fawcett et al. (2007), SCM is the design and management of seamless and value-added processes throughout organisational boundaries in order to meet the needs of the end-consumer. On the other hand, Bechtel and Jayaram (1997) suggested critical insights into SCM related to the concept of strategic alliances, partnerships or cooperative relationships between actors in the supply chain, contrasting with the purely transactional perspective. Similarly, as mentioned by Christopher (2011), SCM focuses on managing relationships between suppliers and customers in order to maximise and deliver profitable outcomes to all members across the supply chain, as well as maximising value to customers. SCM has been widely recognised as a strategic management tool for firms to achieve short-term (e.g., increase productivity, reduce delivery time) and long-term (e.g., increase competitiveness, customer satisfaction and organisational performance) objectives (Chan et al., 2008; Cohen & Roussel, 2005). In other words, SCM enables supply chain members to improve both their effectiveness (e.g., improved customer services) and efficiency (e.g., cost reduction) in a strategic context, thereby achieving competitive advantage and ultimately profitability (Mentzer et al., 2001; Sukati et al., 2012).

SCM originally comprised four key areas: raw materials supply, production planning, logistics and customer demand (Hua, 2013). It has also emerged as mutual practices across industries, such as joint planning, cross-organisational logistics management, information sharing, inventory management, supply-buyer partnerships and long-term strategic alliances (Karami et al., 2014). However, despite substantial efforts by firms and their partners, there remain significant barriers to SCM implementation, such as a lack of collaborative relationships, visibility of customer demand, sharing information and trust, as well as insufficient information system/technology investment throughout the supply chain (Barratt & Oliveira, 2001; Van der Vorst et al., 2007). Therefore, the key drivers of SCM include not only supply chain process optimisation and management, but also supply chain partnership and coordination, supply chain flexibility capability, and information system deployment (Hua, 2013). Subramani and Agarwal (2013) also identified four critical value-adding activities in SCM, consisting of effective governance mechanisms (e.g., using formal contracts and building trust in supply chain relationships), supply chain risk management, quality management and supplier involvement practices.

As organisations become increasingly concerned about being accountable for the sustainability that underlies economics, social and environmental outcomes (Hartmann & Moeller, 2014), sustainable SCM has become a common approach across supply chains, and has sparked substantial interest in both the academic and practice worlds over the past two decades (Hassini et al., 2012; Koberg & Longoni, 2019). Hassini et al. (2012) proposed a framework of sustainable SCM that addressed critical functions in a supply chain, namely, sourcing, transformation, delivery, value proposition, customer and product use, and reuse/recycle/return. In contrast to traditional supply chains, sustainable practices have been integrated across different functions of the sustainable supply chain: sourcing (e.g., using renewable resources), transformation (e.g., sustainable production processes), and customer product and product use (e.g., energy efficiency). To conclude, the focus of SCM has shifted from the management of material and information flows to strategic relationships and collaborations between supply chain members, and then to the sustainability of the supply chain.

2.2.3 Innovation

The extant literature presents a variety of innovation definitions. Innovation was first defined as the ability to create economic value by transforming new ideas into widely used practices and novel outcomes, including a new good, a new production method, a new market, a new organisational structure or a new source of supply, such as improved or new products/services or processes (Schumpeter, 1934). Following Schumpeter‘s line, Afuah (1998) defined innovation as a combination of the invention, marketing and use of new knowledge and technical skills to create new products/services for consumers. The Organisation for Economic Co-operation and Development (OECD, 2000) has provided a commonly used definition of innovation, namely, the implementation of significantly improved or new products and processes, marketing methods and organisational methods in workplace organisation, business practices or external relations. More recently, Crossan and Apaydin (2010, p. 1155) formulated a broader definition of innovation, as the –production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome”. Unlike previous definitions, this comprehensive definition captures new, important aspects of innovation. For example, it highlights intended benefits of innovation (value-added); it emphasises innovation as a creative process by including application (exploitation); and it addresses the two facets of innovation (process and outcome). The definition of innovation was further developed and operationalised by OECD/Eurostat (2018, p. 20) as –a new or improved product or process (or combination thereof) that differs significantly from the unit‘s previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)”. This newest definition emphasises two main types of innovation –product and business process innovation – and further clarifies the requirement for _significant‘ changes, by comparing both improved and new innovations to a firm‘s existing business processes and products.

In short, the term innovation has evolved over time and the scope of meanings is vast. Although many scholars have produced their own definitions of the concept, there are several common elements in the diverse definitions: a focus on the improvement and newness that result from the provision of more effective products/services, processes and business models, and on the importance of innovation outcomes and usefulness. Figure 2.3 summarises the development of the concept, using some key definitions in the literature.

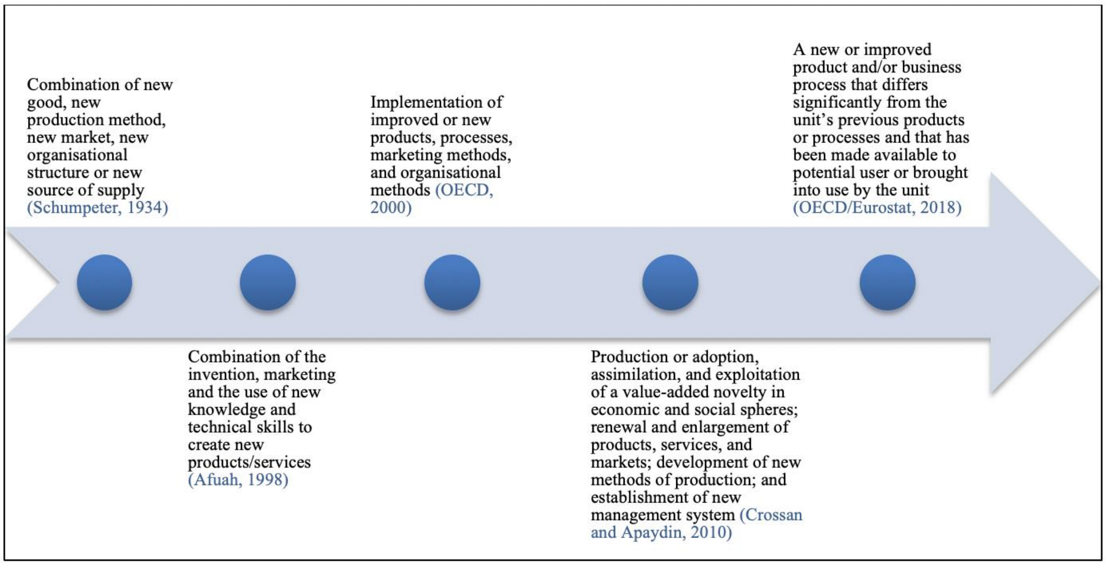

Figure 2.3: Key definitions of innovation and the concept evolution

Innovation has been studied from many perspectives and conceptualised in different ways, leading to a multi-dimensional concept. Camisón-Zornoza et al. (2004) synthesised the theoretical dimensions of innovation in the literature, which consist of the stage of innovation process (i.e., generation and adoption of innovation), the level of analysis (i.e., organisation, industry), the type of innovation (i.e., technical-administrative innovation, product-process innovation, radical-incremental innovation), and the scope of innovation (i.e., number of innovations adopted).

Innovation has been a key contributor to the superior performance and competitive advantage of firms (Berghman et al., 2013; Hoover Jr et al., 1996; Porter, 1990). Most firms today are engaged in innovative practices as a vital condition and competitive strategy for their survival, success and value creation (Fagerberg et al., 2005; Hult et al., 2004). For example, innovation-oriented firms focus on developing new ideas and creativity to gain market success and customer satisfaction, thereby achieving long-term customer relationships and value creation (Lii & Kuo, 2016). Innovation implementations also contribute to quality improvements, cost reductions and productivity gains, while at the same time satisfying the expectations of external and internal stakeholders, leading to improved financial performance for firms (Piening & Salge, 2015). From the perspective of dynamic capability-building, innovative firms which adopt innovative practices are more likely to be able to mobilise their resources and associate their processes in dynamic situations (Agarwal & Selen, 2009, 2011, 2013).

2.3 Supply chain innovation

2.3.1 The concept development and definition

Innovation has been increasingly viewed as a collaborative practice rather than the effort of a single organisation (Chesbrough et al., 2006; Parker, 2000). According to Swink (2006, p. 37) ―the organisation‘s ability to collaborate is key to its innovative success". Indeed, a large part of a firm‘s innovation capability lies in its external relationship network (Bessant et al., 2012), and moving beyond organisational boundaries with customers and suppliers is an important source of value creation (Bowersox et al., 2000). Therefore, the focus of innovation has shifted from intra- to inter-organisational relationships, more so for supply chains or value networks (Agarwal & Selen, 2013; Ageron et al., 2013; Bello et al., 2004). This leads to the notion of SCI that has evolved in both the academic and practice worlds in recent years.

The concept was first developed in relation to business processes and logistics management, such as the pull production systems of Toyota, and, in the second half of the twentieth century, relates more to improvements in business processes and new forms of partnerships (Arlbjørn et al., 2011). It has subsequently been applied to various areas that are more systematically associated with the SCM field, such as supply chain business process optimisation (e.g., Bello et al., 2004; Holmström, 2000), logistics excellence (e.g., Jayaraman & Luo, 2007; Little, 2007; Selviaridis & Spring, 2007), and supply chain technology implementation (e.g., B. Santos & L. Smith, 2008; Wu & Chuang, 2010). Prior studies have defined SCI from different perspectives. There are several definitions of SCI in the extant literature. Bello et al. (2004) defined SCI as a combination of developments in information technologies with new logistics and marketing procedures (e.g., automated ordering, continuous replenishment, ERC). Dubey (2012) described SCI as the use of technologies such as ERC (Efficient Consumer Response), VMI (Vendors Managed Inventory), ERP (Enterprise Resource Planning) and RFID (Radio Frequency Identification Device) to improve information, product and financial flow throughout the supply chain. Arlbjørn et al. (2011) formulated the first comprehensive definition and the model of SCI.

> SCI is “*a change (incremental or radical) within a supply chain network,* supply *chain technology, or supply chain process (or a combination of these) that can take place in a company function, within a company, in an industry or in a supply chain in order to enhance new value creation for the stakeholder*” (Arlbjørn et al., 2011, p. 8).

In line with this definition, the model of SCI consists of three key elements: SC technology, SC network structure and SC business process (Arlbjørn et al., 2011), as shown in Figure 2.4. SC technology involves various technologies (e.g., ERP, GPS, RFID and internet-based practices), which can be applied individually or in combination with the other elements in the SCI model to facilitate better management of information and materials flow across supply chain partners. According to Piening and Salge (2015), technologies can alter innovation capabilities, business practices and strategies while increasing the possibilities of innovation. The number of members operating in the supply chain and their relationships facilitate different network structures, wherein e.g., the vertical structure involves the number of tiers within the supply chain, while the horizontal structure refers to the number of suppliers/customers represented in each tier. Outsourcing, collaboration or partnership within the supply chain can be examples of supply chain network structure innovation (Arlbjørn et al., 2011). The third element, business process, is “a structured, measured set of activities designed to produce a specified output for a particular customer or market” (Davenport, 1993, p. 5). The business processes in SCM include procurement, order fulfillment, manufacturing, and supplier and customer relationship management.

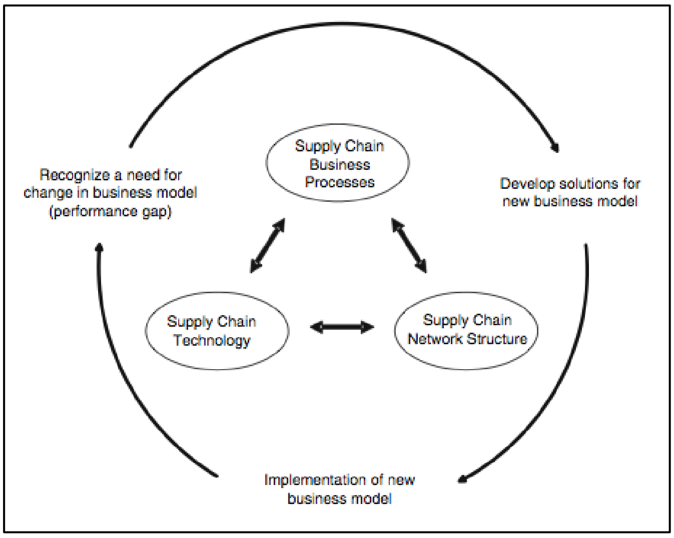

Figure 2.4: Model of SCI (Arlbjørn et al., 2011)

More recently, based on their systematic literature review, Gao et al. (2017) proposed another holistic definition of SCI as:

> ―*An integrated change from incremental to radical changes in product, process, marketing, technology, resource and/or organisation, which are associated with all related parties, covering all related functions in supply chain and creating value for all stakeholders*" (Gao et al., 2017, p. 1530).

The novelty of this definition, compared to the SCI definition by Arlbjørn et al. (2011), mentioned previously, is that it consists of a set of innovative organisational activities associated with all stakeholders and covers all related functions of a supply chain. The innovation activities comprise product innovation (e.g., changes in product properties or new products launching), process innovation (e.g., improve delivery), marketing innovation (e.g., product packaging redesign), technological innovation (e.g., e-procurement), organisational innovation (e.g., improve workplace organisation), and resource allocation innovation (e.g., outsourcing). The major functions in the supply chain include: sourcing, transformation, delivery, value proposition, customers, product use, and recycling (Hassini et al., 2012).

Given the above, the varied conceptualisations of SCI and the concept‘s evolution can be depicted as Figure 2.5.

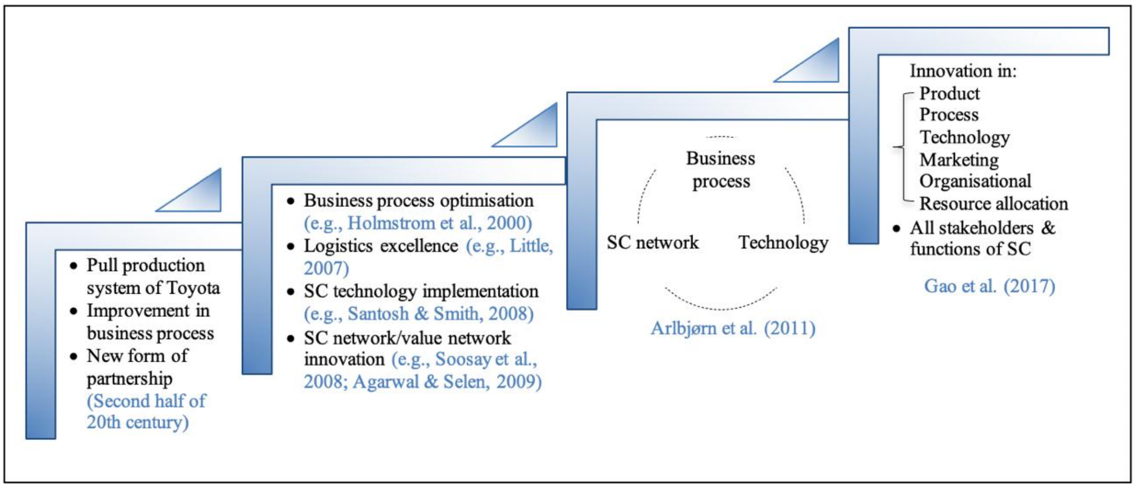

Figure 2.5: The evolution of SCI conceptualisations

The definition of SCI proposed by Gao et al. (2017) forms the basis of this study. In this regard, this study focuses on three critical aspects of SCI: (1) the degree of innovation, which varies from incremental to radical, (2) the innovation approach that focuses on the three most common types of innovation: product, process and technology innovation, and (3), the scope of innovation, involving multiple functions in the supply chain to bring value to different stakeholders in the chain.

2.3.2 Innovative supply chain practices

Innovative supply chain practices comprise a set of tools or methods, which previously did not exist in firms and/or their subsidiaries and will be deployed and developed within the supply chain to deal with different issues such as costs, quality and lead time in the supply chain (Ageron et al., 2013). The authors examined a number of innovative supply chain practices at three different levels to propose a typology of innovative supply chain practices, as shown in Figure 2.6.

At the top level, innovative supply chain practices involve managerial processes including e.g., better coordination between subsidiaries, logistics service outsourcing, logistics hub creation, centralised purchasing processes, vendor managed inventory (VMI), supplier managed inventory (SMI), supply pull processes elaboration, new product co-conception with suppliers, reverse logistics processes deployment, supply chain contracts, and good manufacturing practices implementation. Of those, upstream innovations such as VMI and SMI are the most important. Innovations dealing with the issues of subcontracting, planning, postponement and coordination of subsidiaries are developed to improve firm performance and customer satisfaction. Innovations in logistics, involving partnerships with logistics service providers, facility location and transportation, are also important considerations for firms.

Second-level innovative practices are usually based on the adoption of information system/information technologies such as ERP deployment, Internal or external information system harmonisation, web-based SMI development, traceability systems, information system utilisation for stock management, and reverse logistics. While implementation of ERP and stock management systems are major goals for firms, use of supply chain tools/technologies, in particular Web-based SMI, and business intelligence are the most widely used practices by firms. The adoption of Information system/information technologies greatly benefits firms and their supply chain partners by integrating traceability and reducing inventories in the supply chain, consequently improving supply chain performance.

The third level of innovative practices, which is associated with operational processes, comprises e.g., advanced supplier warehouse, centralised regional distribution hub, outsourcing, new assembly line or new machine tool, Just-in-time stock control, and new transportation organisation. At this operational level, the development of logistics processes such as advanced supplier warehouse, hub creation and stock issues are vital innovative practices (Ageron et al., 2013).

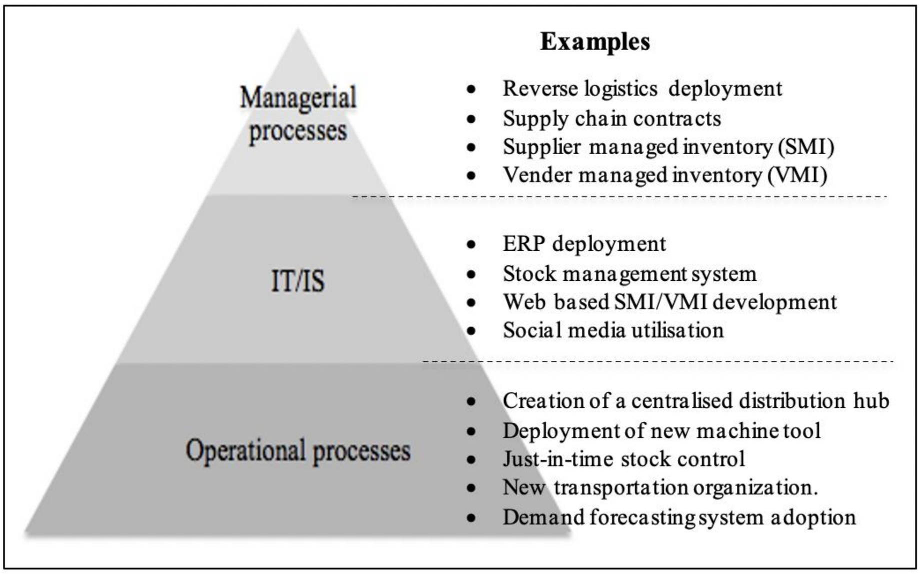

Figure 2.6: Typology of innovative practices in SC (adapted from Ageron et al., 2013)

In practice, a number of innovative practices have been adopted by many firms and supply chains, spanning multiple industries such as manufacturing, services and IT. Examples are Toyota‘s pull production and Kanban system, Dell‘s Make-to-order model, UPS‘s Last-mile delivery, etc. The 2019 ―Supply chain innovation award”, which is organised and selected by ACSCMP (American Council of Supply Chain Management Professionals) has recognised end-to-end supply chains implementing technology-related innovative practices such as Snap-on-tools (reducing shipping costs using AI), Intel (the ―double dip” transforming supply chains and bringing revenue), AGCO (global network digitalisation using smart logistics), and the Erie St. Clair Local Health Integration network (transforming a service supply chain based on ―hospital to house calls”).

2.4 Assessment of agricultural supply chain and Vietnamese agricultural supply chain

2.4.1 Distinctive features of agricultural supply chain

An agricultural supply chain, as depicted in Figure 2.7, generally comprises three parts: upstream, which includes manufacturers/suppliers of various machinery and inputs (e.g., fertilisers, pesticides, hybrid seeds, fuel); midstream, which includes intermediaries (e.g., pickers, processors, storage, transport facilitators, exporters, marketers, distributors, wholesalers, retailers); and downstream, which includes consumers (Priya & Vivek, 2016). An agricultural supply chain is also defined as a set of activities in a sequence of ―farm-to-fork”, including growing (e.g., land cultivation, production of crops), processing/handling, testing, packaging, storing/warehousing, transportation, distribution and marketing (Tsolakis et al., 2014).

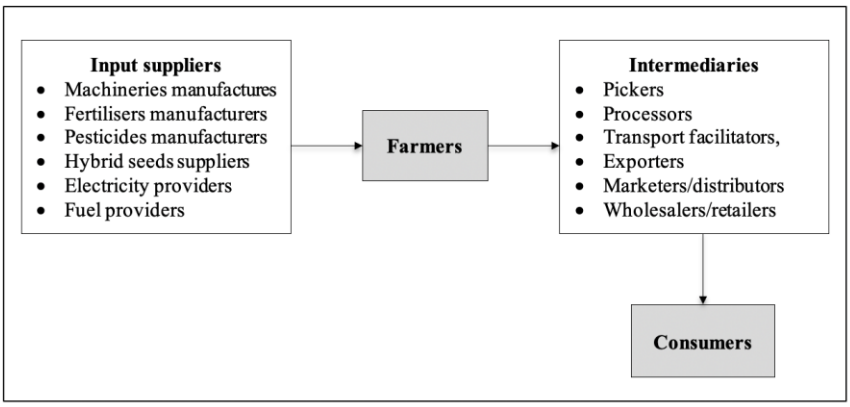

Figure 2.7: Generic agricultural supply chain (adapted from Priya & Vivek, 2016)

Routroy and Behera (2017) identified major operational issues of the agricultural supply chain, including food quality, safety and perishability, and post-harvest loss. The distinctive feature of the agriculture supply chain is the significant and continuous change in product quality across different stages in the supply chain until final consumption (Lemma et al., 2014). For example, product that are high quality at their origin may undergo quality decay due to inadequate practices, in particular, inefficient handling/packaging or inadequate storage/transportation conditions in sequent stages within the supply chain (Van der Vorst et al., 2007). Compared with other supply chains, the agricultural supply chain is more difficult and complex to manage due to the perishable nature of agricultural produce, which is usually impacted by physiological, chemical and microbial processes after being harvested, leading to a deterioration in produce freshness (Aung & Chang, 2014). Post-harvest loss refers to the degradation in both food quantity and quality that mainly occurs during harvesting, storage and transporting. It was reported that 30-35 per cent of food waste in many countries, such as India, is due to inefficient processing and infrastructure in the industry (Parwez, 2013). Other factors that affect agricultural supply chain performance include inadequate connectivity or poor linkage in marketing channels, unskilled labour and a lack of effective government policies (Rais & Sheoran, 2015), and a lack of stringent norms for food quality and safety control (Naik & Suresh, 2018).

Meanwhile, agriculture has increasingly important for feeding the world‘s booming population. In addition, recent trends such as increased variety of products, seasonal variations, increased regulatory complexity, shorter product-life cycles, globalisation of marketing and just-in-time delivery systems have placed pressure on agricultural supply chains to achieve optimal performance (Gebresenbet & Bosona, 2012; Van der Vorst et al., 2007). The role of agricultural supply chains has been further challenged by growing consumer attention to food safety, quality and traceability, as well as by retailers‘ demands for larger volumes of reliable and consistent products (FAO, 2012; Gebresenbet & Bosona, 2012). The solutions to overcoming these issues and challenges should not be limited to improving product quality and safety through the adoption of quality management policies and traceability systems, but should also include fostering partnerships among supply chain stakeholders and implementing innovative farming applications (e.g., IT), as well as ensuring supply chain sustainability, etc. (Tsolakis et al., 2014).

Further characteristics of the agricultural supply chain and their impacts on logistics and SCM can be found in Table 2.1.

Table 2.1: Main characteristics of agricultural supply chain

SC stage	Product and process characteristics	Impact on logistics and SCM
Overall	o Shelf-life constraints for raw materials, intermediates and finished products o Changes in product quality at various level in the supply chain (decay) o Material recycling required	o Timing constraints o Information requirements o Return flows
Producers/ Growers	o Seasonality in production o Variation in consumer preferences and demands o Variability of quantity and quality of supply o Long production times, particularly when producing new/additional products	o Flexibility in process and planning o Responsiveness o Need of effective demand forecasting
Processors	o Variable process yields in quality and quantity due to seasonality, biological variations, random factors like pests, weather, or other biological hazards o Highly capital-intensive machinery that requires the maintenance of capacity utilisation o Low variety and high-volume production systems o Storage buffer capacity is restricted, especially when material/intermediates/finished products can only be stored in special tanks/containers o Product-dependent cleaning and processing times, alternative recipes and installations. o Necessity to value all parts due to the complementary nature of agricultural inputs (i.e., beef cannot be produced without the co-product hides) o Necessity for the traceability of work in process because of quality and environmental requirements and product responsibility	o Timing constraints and ICT- possibility to confine products o Importance of production planning and scheduling, high capacity utilisation requirement o Flexibility of recipes and production planning o Need for configurations that facilitate tracking and tracing
Wholesalers/ Retailers	o Seasonal supply of products that requires global sourcing o Variability of quality and quantity of supply o Requirements for conditioned storage and transportation means o Variation in consumer preferences and demands	o Timing constraints o Need for conditioning o Pre-information on quality status of products o Pricing issues o Need of effective demand forecasting

Source: *adapted from Van der Vorst et al. (2005)*

2.4.2 Analysis of Vietnamese agricultural supply chain - rice and coffee supply chain

2.4.2.1 Overview of Vietnam's agriculture – current situation and issues

Agriculture is one of the most important economic sectors in Vietnam, accounting for almost 15% of the country's GDP (GSO, 2020). The sector is also a key source of employment, with almost half of the population involved in agricultural activities (MARD, 2020). Besides production for a growing domestic demand, the country has become a major exporter of agricultural commodities in international markets. In particular, Vietnam was the world's fifth largest rice exporter and second largest coffee exporter in 2019. Table 2.2 shows information about the global ranking of rice and coffee exports in 2019. The strengths of Vietnam's agriculture also lie in its diverse agri-ecological conditions and its favourable geography, located near to growing middle-income countries. Other factors such as improved domestic investment in agriculture and the increasing global customer demand for agricultural products signal a greater potential for Vietnam's agriculture (World Bank Group, 2016).

Table 2.2: The world's top five rice and coffee exporter in 2019

Product	Rank	Export (1000 metric tons)
Rice	1. China	209.6
	2. India	177.6
	3. Indonesia	54.6
	4. Bangladesh	54.6
	5. Vietnam	43.4
Coffee	1. Brazil	3009
	2. Vietnam	1684
	3. Colombia	885
	4. Indonesia	761
	5. Ethiopia	482.5

Source: *FAOSTAT (2019)*

However, Vietnam's agriculture has many limitations and shortcomings that impact on the productivity and performance of the sector. For example, although Vietnam has been successful in exporting agricultural products, the country has suffered from low prices, low quality and low value-added in its exports (Dao & Nguyen, 2015; OECD, 2015). Most of its agricultural products are still exported in raw or initially processed form (e.g., green coffee and milled rice), and are sold at discounted or lower prices, compared to those of its leading competitors. This is due to the inconsistent or low quality of the products, or problems related to food safety in Vietnam (Pham et al., 2017). In other words, Vietnamese agricultural exports are commonly derived from low-value commodity sales, which are developed based only on export volume rather than quality and value-added. It is further evident that the Technical Barrier to Trade (TBT), which involves a full range of technical and safety standards for importing countries, has also posed a major challenge for Vietnamese agricultural exports (World Bank Group, 2016). Thus, Vietnam has failed, to date, to take full advantage of export market opportunities.

In addition, labour productivity of Vietnamese agriculture is very low. Insufficient investment in machinery and technology occurs in different processes (e.g., harvesting, processing, storage). Many small-scale farms still use family members as the main labour for different operations, which are mainly based on traditional and manual farming practices. Other inefficient processes such as poor packaging or inadequate transport systems also lead to increased costs, a high loss and damage rate, and low quality of finished products (Pham et al., 2017). Many smallholder farmers still struggle with low income from coffee production as a result of their imperfect knowledge, lack of information and, consequently, unfavourable trading prices (Nguyen & Bokelmann, 2019; World Bank Group, 2016).

Vietnam‘s agriculture has also faced sustainability issues. A large proportion of Vietnam‘s agricultural production has stemmed from intensive use of land and other natural resources, and relatively heavy use of fertiliser and other agri-chemicals. For instance, many small-scale coffee growers still use unsustainable farming practices that cannot meet sustainability standards, such as inappropriate disposal of solid waste, poor fertility management and heavy use of pesticides with negative impacts on the environment (e.g., pollution, soil degradation) (Nguyen & Sarker, 2018). Such sustainability issues have affected the productivity and international view of Vietnam‘s agricultural products, in particular rice and coffee. Meanwhile, the sector has also dealt with increasing competition for other land uses such as industrial and urban purposes (World Bank Group, 2016). Current trends such as climate change, rapid economic growth and rising populations, combined with expanding agricultural production, all of which are exerting massive pressures on the environment, are likely to have strong negative impacts on Vietnamese agriculture (OECD, 2015).

Vietnam‘s agriculture has also faced problems associated with the inefficient value chain of agricultural products. First, most agricultural supply chains feature a large number of intermediaries, and consequently the capabilities, business ethics, financial strength and technologies used in agriculture vary across these intermediaries. This makes it difficult to ensure the quality and safety of original products and make commitments between supply chain actors. Secondly, the lack of strong collaboration among these actors can lead to, e.g., inefficiency in production/process occurring at every stage of the supply chain, and instability in prices and quality. Furthermore, the quality and safety control of agricultural products in Vietnam is low. For instance, low-cost Robusta coffee is sometimes blended with Arabica coffee to produce a different brand of instant coffee; fresh produce is usually unlabelled or even labelled with a different origin (World Bank Group, 2016).

Against this backdrop, Vietnam needs to develop large-scale, modern and sustainable agriculture production by adopting innovations to enhance the quality, productivity and competitiveness of the sector. This development plan must be based on innovative thinking, efficient use of land and water resources, rapid application of scientific and technology achievements, and flexibility to adapt to climate changes. Other strategies, such as continuing to facilitate agricultural diversification to respond to increasing food demand, supporting broad-based innovation across agricultural and food sectors, and strengthening collective actions to build competitive value chains, are also required to drive the efficiency of agriculture (MARD, 2020). In sum, the future growth of Vietnamese agriculture will rely primarily on increased efficiency, innovation, diversification and value- addition.

As the focus of the empirical investigation in this study is based on rice and coffee supply chains, this section next analyses typical rice and coffee supply chains, in order to provide further understanding of the research context.

2.4.2.2 Rice supply chain

As shown in Figure 2.8, the rice value chain includes three main channels. First, the direct channel between growers (e.g., farmers, cooperatives) and food companies/exporters. Although this is the most effective and the shortest channel, its proportion is very low (only 4.2%). Second, the three-level channel, where paddy from farms goes through processing mills (e.g., dehusking, polishing factories) and food companies/exporters, before the final consumption of rice in either the foreign or domestic market. Third, the longest supply chain, which comprises many levels: from growers to local traders/collectors, processing mills and food companies/exporters, to wholesalers/retailers and final consumers. This channel, making up the largest proportion, addresses the vital role of local traders/collectors in the rice value chain (Demont & Rutsaert, 2017; Vo & Nguyen, 2011).

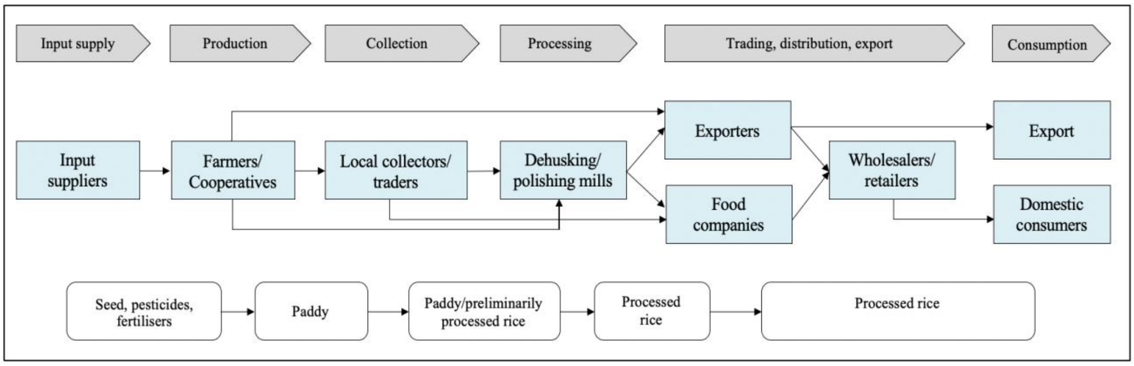

Figure 2.8: Rice value chain in Vietnam (adapted from Vo and Nguyen (2011) and Demont and Rutsaert (2017)

The processes and cooperation between the actors within the longest supply chain can be described as follows: paddy grown by farmers is sold to local collectors/traders, who evaluate and determine the paddy quality and price. The traders first process and resell the paddy, either to processing mills or food companies/exporters. In some cases, paddy is sold to small-scale mills (e.g., dehusking mills) before being transported to medium/large mills for further processing (e.g., polishing), then to regional food companies/exporters. From here, the rice is exported or sold to end-consumers in the domestic market through different channels, such as wholesalers, supermarkets or traditional retailers.

Rice is the key national commodity, contributing around 30% of the total production value of the cultivation sector in Vietnam (MARD, 2020). Vietnam has continuously been ranked in the top five (previously top three) rice exporters in the world (recall Table 2.2). However, the perceived image and growth track of the country‘s rice sector are as a producer and supplier of low-quality rice worldwide. A large part of Vietnamese rice export stays within Asian markets such as China and the Philippines. Exports to other markets are affected by strong competition from India and Thailand (Demont & Rutsaert, 2017). In particular, the rice supply chain is remarkably inefficient, and generally characterised by the following features:

- The biggest issues of the rice supply chain are fragmented production, inadequate processes and insufficient investment in machinery and technology across the supply chain. In addition, many farms, local traders, mills and transport facilitators operate on a small scale. Inadequate harvest and post-harvest infrastructure such as processing, packaging and storage lead to a high rate of loss and damage, to heterogeneous quality of product and to poor quality of rice (Demont & Rutsaert, 2017; World Bank Group, 2016). For example, wet paddy is commonly manually semi-dried and stored at farmers‘ houses, then packed in barges and left outside until traders come to collect it. before being transported to mills for processing, with consequent major damage to rice (Jaffee et al., 2012). The inadequate transport infrastructure (e.g., narrow roads or dense watery networks) and facilities (e.g., carts) in many regions of Vietnam are barriers to rice being transported long distances or in large volumes, leading to increased production costs (Dao & Nguyen, 2015; Do, 2017)

- The rice value chain features a large number of intermediaries and poor collaboration among the chain members (Dao & Nguyen, 2015; Jaffee et al., 2012). The presence of many intermediaries, especially the vital role of local traders, is seen to have negative impacts on the rice value chain in terms of increased transactional costs, reduced transparency of product and information flow, and low quality of rice. For example, farmers usually have to sell their rice at a low price to traders due to their inadequate storage or transport facilities, the small volume of their output, and their limited information resources about the market. Processing or food companies then have to buy rice supplied by the traders at a higher price. Additionally, some traders lack appropriate milling, storage and transport facilities, thus reducing the quality of the intermediate rice (Do, 2017). Traders often manipulate the supply, demand and market price of rice, reducing the transparency of rice consumer demand and pricing. Such long supply chains with poor linkages between members lead to an unstable rice quality, or even quality decay, due to the many gaps in knowledge, financial capability, technological investment and business ethics between the chain‘s members.
- The rice supply chain has faced other issues, including poor quality control and ineffective marketing channels, leading to the low quality and inferior competitiveness of Vietnamese rice. Many local traders, small-sized mills and transport facilitators operate in informal/unofficial commercial networks that result in poor quality control of rice within the supply chain. For example, if paddy/rice

quality is low and does not meet the standard requirements due to unfavourable conditions, local traders may still accept and purchase it at a lower price (Do, 2017). In addition, inadequate marketing infrastructure (e.g., the lack of a standardisation and grading system) significantly affects the quality and competitiveness of Vietnamese rice. Export rice is often graded based only on the proportion of broken rice, reflecting the possible mixing of quality and variety (Jaffee et al., 2012). Regarding the rice marketing channel, the flow of traditional/informal markets dominates in most of Vietnam's agricultural supply chains (OECD, 2015). This makes the consumer market highly unstable, thereby reducing the accuracy and effectiveness of demand forecasting.

- The Vietnamese rice supply chain also faces sustainability issues. Over-use of fertilisers leads to high rates of disease and pest infestation, resulting in heavy use of pesticides. The rice sector is also vulnerable to the climate change that causes water shortages in the dry season. A socially unsustainable situation is that many small-scale rice growers are unable to raise their living standards through rice production and therefore have to seek other sources of income (Demont & Rutsaert, 2017).

2.4.2.3 Coffee supply chain

The Vietnamese coffee supply chain generally comprises many functions: inputs supply (2) production, collection, processing, trading and consumption (Nguyen & Mai, 2017). After harvest, coffee grown by farmers is sold to local collectors, traders or coffee processors. Individual farmers can participate in coffee cooperatives or associations. The local collectors act as intermediaries between the farmers and the processing companies, based on their wide network of downstream actors in the supply chain and their credit-bound relationships with farmers. The traders normally purchase coffee directly from farmers or from local collectors, then sell the coffee to processors or roasters. The processing companies engage in different activities including dehusking coffee cherries, quality testing, sorting, roasting, etc., before selling the coffee to either the international or domestic market (Nguyen & Bokelmann, 2019). Figure 2.9 illustrates a typical coffee supply chain in the Central Highlands in Vietnam.

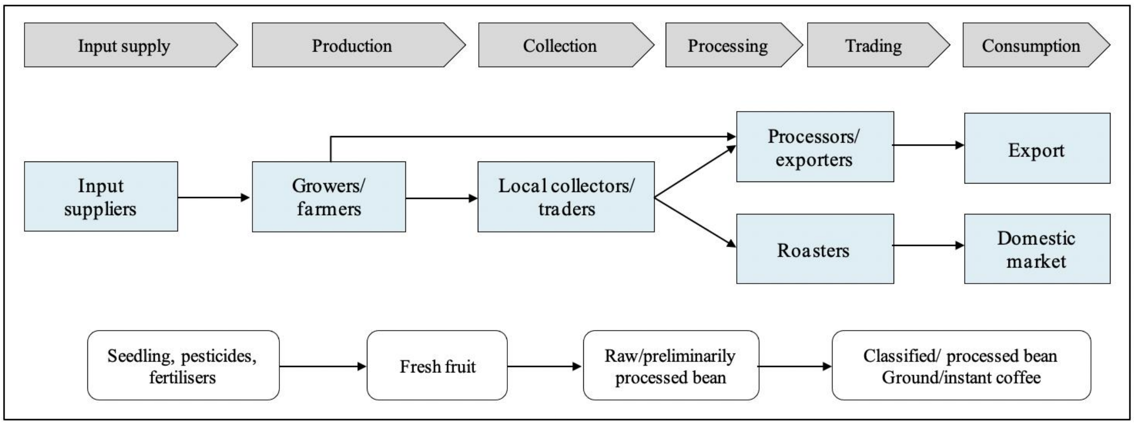

Figure 2.9: Coffee supply chain in Vietnam (adapted from Nguyen and Sarker (2018) and Nguyen and Bokelmann (2019)

Coffee is one of the major export commodities of Vietnam. Vietnam has been the world's second largest exporter of coffee (recall Table 2.2) for the past two decades, behind Brazil (FAOSTAT, 2019; MARD, 2020). However, Vietnam's coffee supply chain has similar issues and challenges to rice, such as numerous intermediaries from farm to consumption, the important role of local collectors/traders (occupying almost 60 per cent of the total value of the chain), small-scale and unsustainable production, simple/outdated farming equipment and technologies, poor quality control and poor infrastructure. This is seen in the Central Highlands, which is the principal and largest coffee-producing coffee region (Nguyen & Sarker, 2018; Nguyen & Mai, 2017; Pham et al., 2017)

In short, the Vietnamese agricultural supply chain in general, and the rice and coffee supply chains in particular, suffer from inefficiencies at different stages across the supply chain. As previously mentioned, common issues include fragmented and unsustainable production, inefficient processes, poor quality management, ineffective marketing channels, huge post-harvest losses, the presence of a large number of intermediaries, and poor linkages between the supply chain members. These problems clearly indicate the need for innovations in the supply chain in order to improve performance. Figure 2.10 presents a summary of the main issues affecting the Vietnamese agricultural supply chain, which are classified into four different groups: productions & processes, quality & marketing, information and knowledge, and collaboration.

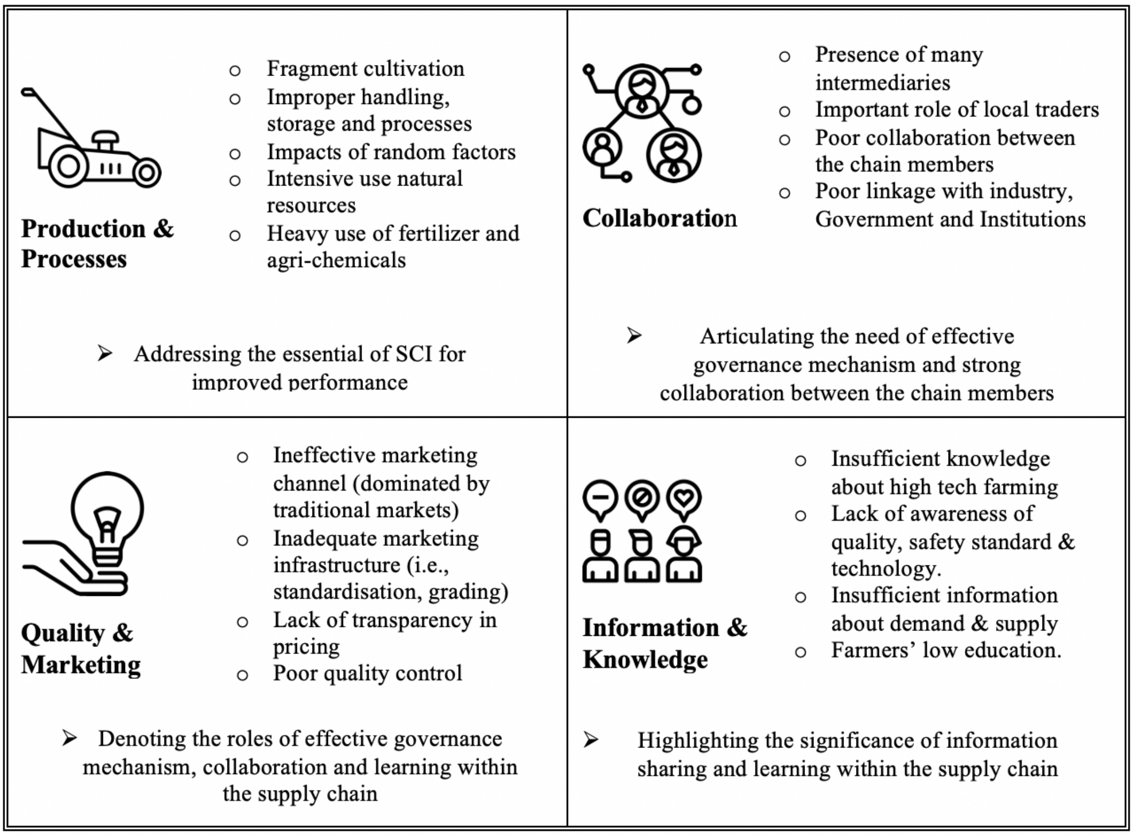

Figure 2.10: Current issues of Vietnamese agricultural supply chain (adapted from multiple sources)

2.5 A systematic literature review of antecedents and consequences of SCI

In order to identify gaps and explore possibilities for the research topic, as well as provide an extensive review of the existing research, this study conducted a systematic literature review of the research topic, the antecedents and consequences of SCI. The systematic review enables integration of a number of different works on the research topic, formulation of a summary of the common elements, and of the differences, and extension of previous works in some fashion (Meredith, 1993, p. 8). In this regard, this study also aimed to develop a unified framework that integrates the three meta-constructs of SCI – dimensions, antecedents and consequences – advanced in the literature. The process, method and findings of the review are reported in following sub-sections.

2.5.1 Process and analysis method of the literature review

To ensure the reliability and validity of the review, content analysis method was employed to assess the extant knowledge about antecedents and consequences of SCI.

Content analysis is a ―research technique for the objective, systematic and quantitative description of the manifest content of communication" (Berelson, 1952, p. 55). It is also defined as an approach that emphasises ―allowing categories to emerge out of data" and ―recognising the significance for understanding the meaning of the context in which an item being analysed (and the categories derived from it) appeared" (Bryman, 2004, p. 542). The content analysis in this study involves different stages, including collecting data, coding data, and analysing and interpreting the coded content (Drisko & Maschi, 2016; Duriau et al., 2007; Weber, 1990).

In order to make the review transparent and auditable, this study followed the process model of content analysis proposed by Mayring (2003), which consists of four steps: material collection, descriptive analysis, category selection and material evaluation. The model is well established, having been successfully applied in previous research in the field (e.g., Beske & Seuring, 2014; Gao et al., 2017; Gold et al., 2010; Seuring & Gold, 2012; Seuring & Müller, 2008). Figure 2.11 describes this process model and its application to this study.

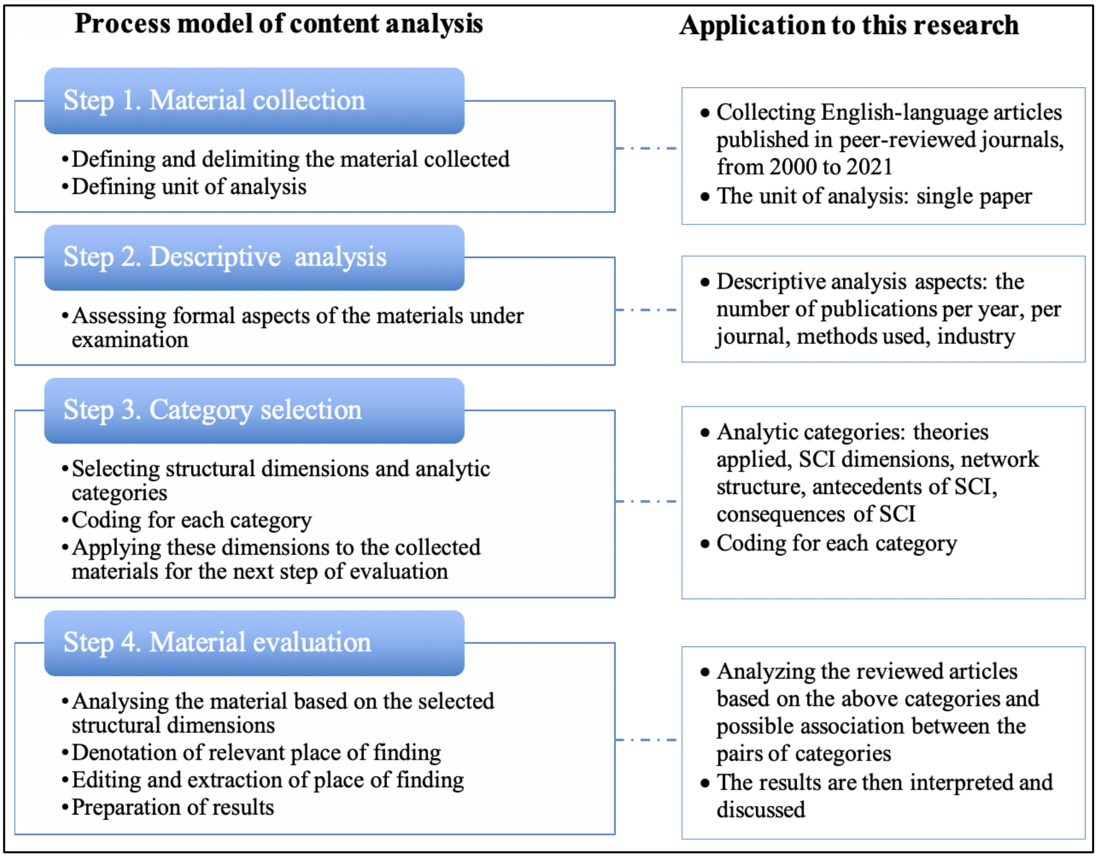

Figure 2.11: The process model of content analysis-based literature review and its application to this study (adapted from Mayring, 2003)

Further details about the methodological aspects of the content analysis model in relation to its application to this review will be discussed next.

2.5.1.1 Delimitation, literature search and materials selection – Step1 of the process model

In this review, the search was limited to peer-reviewed publications published in English. The search timeframe was set for 2000 to late 2019 and then updated to March 2021. The Scopus database was used to search related articles. A structured string based on a combination of multiple key search terms was used to capture the relevant research in titles, keywords and abstracts. Initially, in order to test the relevance of the search result of 3040 articles, abstract analysis was performed for each author. After a careful analysis of the full texts of 253 relevant articles, along with the comparison of all evaluations of authors, 157 valid articles were used for the detailed review. Table 2.3 summarises the delimitation, literature search and selection steps in this study.

Table 2.3: A summary of delimitation, literature search and articles selection in this review

Process	Details	Number of papers found
Literature search	**Key terms for the search:** ○ Terms related to supply chain: supply chain, value chain, or value network ○ Terms related to innovation: innovation, innovate, innovativeness. The term ―innovat*" is used to cover all possibilities. ○ Terms related to antecedents: antecedents, determinant, driver, facilitator, enabler, inhibitor or barrier ○ Terms related to consequences: consequence, outcome, impact, influence or benefit	3040
	Delimitation ○ Year: 2000–present ○ Document type: article	
	DelimitationSyntax searched in Scopus TITLE-ABS-KEY (("supply chain" OR "value chain" OR "value network" AND "innovat*" AND "antecedent" OR "driver" OR "fa cilitator" OR "enabler" OR "determinant" OR "inhibitor" OR "barr ier" OR "consequence" OR "impact" OR "benefit" OR "influence")) AND DOCTYPE (ar) AND PUBYEAR > 1999	
Abstract analysis	**Inclusion criteria:** ○ Having a clear relation to the review topic ○ Written in English **Exclusion criteria:** ○ Having nothing to do with the investigation of antecedents/consequences of innovation under supply chain context via abstract analysis	253
Reading full text	○ Reading the full text of 253 papers by all authors ○ Based on careful analysis, comparison of all evaluations, interactive discussion by authors, deleting articles not really focusing on the research questions	157

2.5.1.2 Descriptive analysis – Step 2 of the process model

The selected articles were initially evaluated through a descriptive analysis to provide a general review of the literature, based on the year of publication, the publication journal, the research method used, and the industry sector of focus. The descriptive result indicated that a total of 157 articles were published from 2002 to early 2021, with at least 12 and up to 19 articles since 2013 (see Figure 2.12). As is shown in Figure 2.13, the reviewed articles have been published in mainstream operations, logistics and supply chain journals, and journals with an emphasis on sustainability. In terms of the methods used in past research, the vast majority of articles (nearly 78 per cent) used quantitative survey-based methods, while 16 per cent were based on case study-based research. Only 6 articles addressed theoretical or conceptual issues. Various industry sectors were encompassed in this research. Nearly half of the reviewed articles focused on the manufacturing sector, while service and multiple industries were also widely studied.

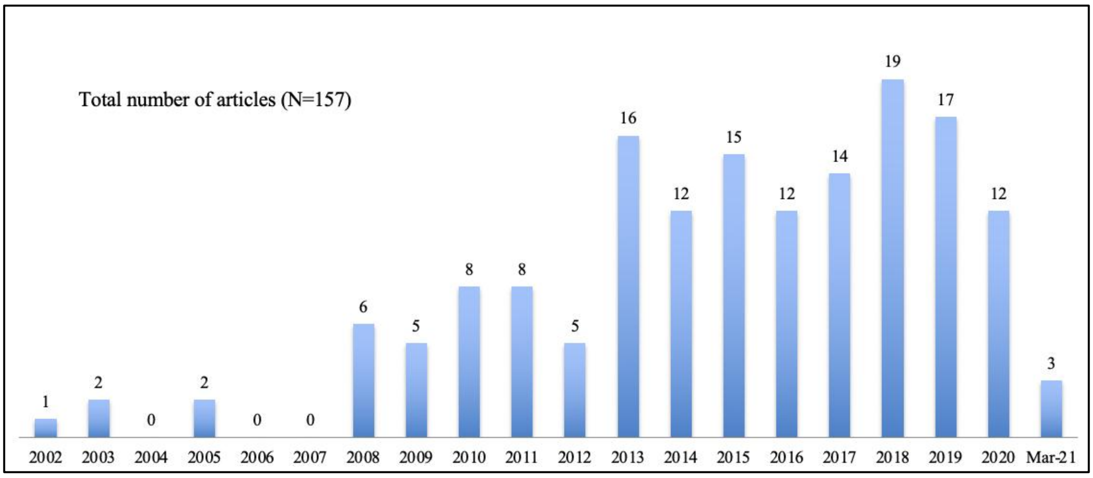

Figure 2.12: Distribution of the articles over the review period

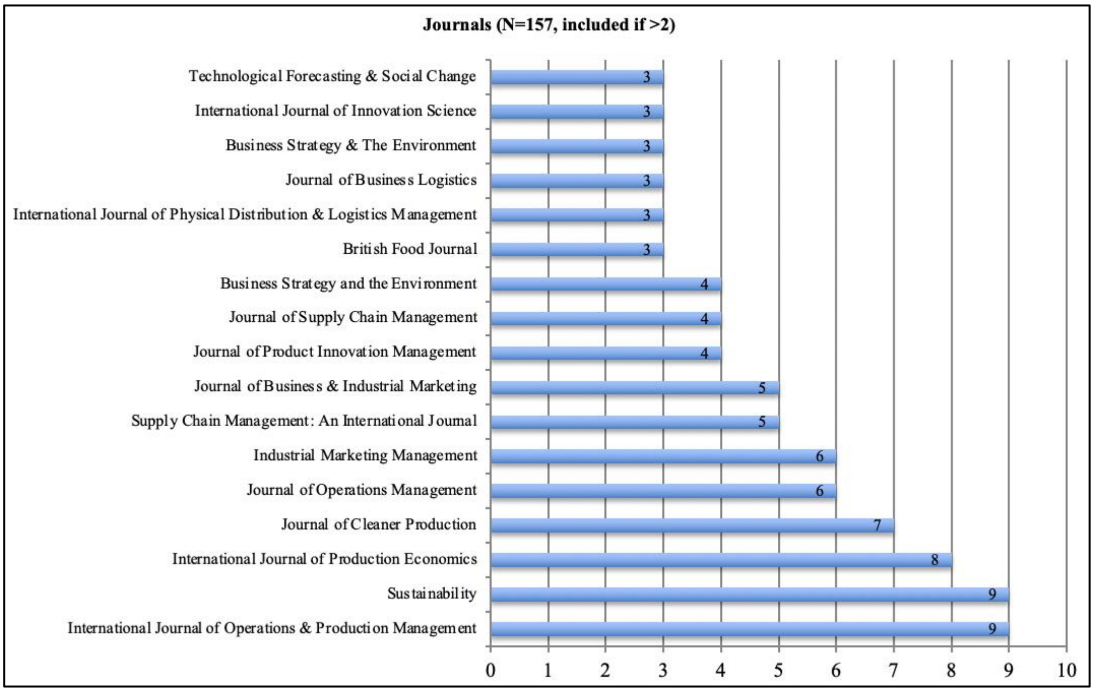

Figure 2.13: Distribution of the reviewed articles by journal

2.5.1.3 Analytic categories selection, coding and analysis - Steps 3 and 4 of the process model

Step 3 involved a categorical analysis that grouped articles aimed at identifying and synthesising SCI dimensions, antecedents and consequences. Sub-categories for each of the aforementioned constructs were also predefined using the following coding:

- The definition of SCI proposed by Gao et al. (2017) forms the basis of this study. In this definition, several dimensions of SCI are recognised: the degree, types and scope of SCI, covering different functions and involving all stakeholders in the supply chain. Arlbjørn et al. (2011) also clarified different scopes of SCI that can take place within a firm, industry or supply chain, as long as it brings new value creations to the related stakeholders. Collectively combining these SCI conceptualisations, the coding classification for SCI dimensions in this review included: i) the degree of SCI, which can be radical or incremental; ii) the types of innovation, which include product, process, technology, marketing etc.; and iii) the scope of SCI that categories innovation within the bounds of a focal firm, in a dyadic relationship, or the supply chain/network.

- Based on the perspectives of Crossan and Apaydin (2010), De Vries et al. (2016) Jenssen and Nybakk (2013) and Kimberly and Evanisko (1981), this study classified antecedents of SCI into three levels: organisational, inter-organisational and environmental.
- The literature on SCI was assessed at two different levels: firm performance, measured as financial (e.g., profits, return on investment), non-financial (e.g., competitiveness, customer satisfaction) and operational performance (e.g., quality, flexibility, reliability) (Leuschner et al., 2013); and SCP, which includes financial, quality, efficiency, flexibility, reliability and responsiveness measures (Balfaqih et al., 2016).

The last step (Step 4) required the evaluation of reviewed articles for the analytic categories and any association between pairs of categories.

2.5.2 Categorical analysis results

Based on the extensive literature review of the 157 articles, a multi-dimensional framework of SCI involving its typology, critical antecedents and consequences was developed.

2.5.2.1 SCI typology

This section presents a typology of SCI that identifies key dimensions of SCI including the degree, type and scope of innovation, as detailed in Table 2.4.

- ❖ Degree of SCI

The degree of innovation can be incremental or radical, where the former makes less fundamental changes and makes continuous improvements to existing products (e.g., updated versions of products/services), while the latter fundamentally changes products through the application of new ideas and advanced technologies (e.g., completely new or novel products/services) (Bessant, 1992; Dewar & Dutton, 1986). As evident from Table 2.4, the majority of articles reviewed exhibited the link between the degree of innovation and its antecedents and/or consequences. Distinguishing SCI based on its degree of novelty is important, as the organisational capabilities required for the implementation of radical innovations require firms to develop completely new capabilities, whereas incremental innovations often reinforce firms‘ existing capabilities (Mol & Birkinshaw, 2014). The degree of innovation is also an effective moderator of the antecedents-innovations relationship. For example, interactive learning has been identified as playing a more significant role in incremental innovations than in discontinuous innovations (Fu et al., 2013). Linder and Sperber (2019) also differentiate between the impacts of external and internal knowledge on innovations; external knowledge prompts incremental innovations, while internal knowledge acts as a promising source for radical innovations. Thus, investigating a research problem with different degrees of innovation is essential if firms and their partners are to develop appropriate innovation strategies

- ❖ SCI types

The distinction between innovation types is important for understanding the innovative behaviours of organisations, since the adoption of each type requires different skills and focuses. For example, product innovation requires a market focus, whereas process innovation has an internal focus (Damanpour & Gopalakrishnan, 2001). In the current study, our findings indicate that nearly one-third of the research has been linked to the innovation type/approach, and most of it centres on product, process or technological innovation. Product innovation refers to new products/services introduced to meet market need or customer demand, whereas process innovation relates to introducing new elements into production processes or service operations, such as task specification, input materials or equipment (Damanpour & Gopalakrishnan, 2001; Utterback & Abernathy, 1975). Technological innovation brings changes to organisations through the introduction or use of technologies such as new tools, devices or systems (Damanpour, 1987). Product innovation is the most common innovation type in the research, with less research examining process and technological innovation. It is necessary to emphasise that most of the research has focused on a particular type of innovation, apart from a few studies that have considered a combination of product and process innovation. This suggests that there has been a lack of research covering multiple types of innovation towards a complete SCI, especially research investigating marketing (e.g., product packaging redesign), organisational (e.g., improving workplace organisation) and resource allocation innovation (e.g., outsourcing) (Gao et al., 2017), which have not been investigated in past studies.

Another stream of the literature addressed other types of innovation that are receiving growing attention in research, such as logistics innovation (i.e., logistics excellence), service innovation (i.e., new service offering creation) and green/ecological/sustainable innovation (i.e., environmentally friendly products or processes). Among these, there has been increasing interest in investigating green/eco-/sustainable-oriented innovation in recent years.

❖ SCI scope

In the current review, the scope of SCI can be differentiated into three levels of involvement by supply chain stakeholders: a focal firm, a binary relationship (i.e., supplier-buyer relationship), and a supply chain relationship (i.e., involving multiple actors or all stakeholders in the supply chain). The findings reveal that studies assessing SCI for individual firm and binary relationships are the key contributors to the literature. Innovation stimulated and adopted by different members across the supply chain remains scarce in the research. This is despite SCI being expected to involve and bring benefits to all actors, and to improve the performance of the entire supply chain (Gao et al., 2017).

- To sum up, SCI has been studied as a multi-dimensional concept. A majority of past research viewed SCI as a process involving different dimensions, especially the degree, type and scope of innovation, as discussed previously. Nevertheless, some studies considered innovation from other perspectives, such as innovation capability (e.g., Singhry, 2015), innovation success (e.g. Chowdhury et al., 2017) and development of innovation (e.g. Lambrecht et al., 2015), that were not applicable to any of the identified dimensions. This highlights the varied conceptualisations of SCI in the existing literature. Occurrences of the identified SCI dimensions are summarised in Table 2.4. Although the review has identified three main dimensions of SCI, it is recognised that these dimensions and their components are usually intertwined, generating hybrid forms such as radical-service innovation (e.g., Chester Goduscheit & Faullant, 2018) and green-product/process innovation (e.g., Hofman et al., 2020; Zailani et al., 2015).

Table 2.4: Classification of SCI dimensions in the literature

Dimensions of innovation	Components	Focus and/or example	Represented research
Degree of SCI	○ Radical innovation ○ Incremental innovation	○ Fundamental changes in products with application of new ideas and advanced technologies (e.g., completely new or novel products/services) ○ Less fundamental changes and continuous improvements to existing products (e.g., updated versions of products/services)	Song and Di Benedetto (2008), Soosay et al. (2008), Nguyen et al. (2009), Bouncken (2011), Fu et al. (2013) Yunus (2018)
Type of SCI	○ Product innovation	○ New products/services introduced to meet market need.	Jajja et al. (2014), Liao and Barnes (2015), Thu et al. (2018), Wagner (2010)
	○ Process innovation (or a combination of product and process innovation)	○ New elements introduced into production processes or service operations such as task specification, input materials or equipment	Ju et al. (2016), Sabri et al. (2018), G.-C. Wu (2013), Lisi et al. (2019)
	○ Technology innovation	○ Technological innovation brings changes to organisations through introducing or using technologies such as new tools, devices or systems	Babalola et al. (2015), Lee et al. (2014), Linton (2018)
	○ Logistics innovation	○ Logistics-related processes/activities/services perceived as new and useful in production of a particular product (e.g., increased precision in tracking packages and freight)	Grawe et al. (2011), Grawe et al. (2014)
	○ Service innovation	○ New or significantly improved service concept or offering (e.g., new customer interaction channel)	Agarwal and Selen (2013), Kindström et al. (2013), Li et al. (2018)
	○ Sustainable, green or eco-innovation	○ New production or exploitation of a product/process aims to reduce , pollution, environmental risks, and other negative impacts on resource used (e.g., environmentally friendly production processes and green products)	Jajja et al. (2017), Seman et al. (2019), Zailani et al. (2015), Zhang et al. (2021)
Scope of SCI	○ Individual firm	○ Innovation adopted by a focal firm	Gölgeci and Ponomarov (2015), Krolikowski and Yuan (2017), Salunke et al. (2011)
	○ Dyadic/binary relationship	○ Innovation involves a firm and their key partner such as customer or supplier	Azadegan and Dooley (2010), Kim and Chai (2017), Panayides and Lun (2009)
	○ Supply chain/value network	○ Innovation involves multiple actors in a supply chain or a network of firms	Carnovale and Yeniyurt (2015), Theyel (2013), Agarwal and Selen (2013), Kibbeling et al. (2013), Kabadurmus (2020)

2.5.2.2 Antecedents of SCI

Various antecedents referred to as drivers, facilitators, determinants, enablers or inhibitors of SCI were identified at three levels: organisational, inter-organisational and environmental. The relevant theories, including the Resource-Based View (RBV) (Barney, 1991), Knowledge-Based View (KBV) (Grant 1996), Resource Dependence Theory (RDT) (Preffer & Salancik, 1978), Dynamic Capability (DC) (Teece et al., 1997), Transaction Cost Theory (TCT) (Williamson, 1979) and Social Exchange Theory (SET) (Emerson, 1976), were used to consolidate the SCI antecedents at three levels – organisational, inter-organisational and environmental.

❖ SCI antecedents at organisational level

The findings indicate that a relatively large number of studies explored the relationship between SCI and internal organisational factors, such as culture and core capabilities of organisations. These internal organisational factors play a strategically important role in innovation. Existing RBV (Barney, 1991) and DC (Teece et al., 1997) theories emphasise that a firm‘s imitable and valuable resources, and its ability to build, integrate, extend and reconfigure resources, enable it to achieve competitive advantages and address fast changing environments (Barney, 1991; Teece et al., 1997).

According to RBV, organisational culture is valuable, unique and an important driving force for innovation and sustainable development (Barney, 1986). Organisations that value culture always show care for the environment and society, and this is evident in their business operations (Bag & Gupta, 2017). Organisational culture typically includes social responsibility (Tantayanubutr & Panjakajornsak, 2017), environmental ethics/compliance (El-Kassar & Singh, 2019; Lee & Kim, 2011) and regulation awareness (Hasler et al., 2016). Strategic orientation is another organisational cultural factor enabling SCI; for example, customer and competitor orientation (Grawe et al., 2009), whereby an understanding of the values and needs of targeted customers is communicated within a firm (Narver & Slater, 1990). This can help the firm to anticipate changes in customer needs and innovate to improve or develop new products/services (Micheels & Gow, 2008).

Technological capabilities (IT infrastructure flexibility and technological diversity) are also considered critical sources of SCI (e.g., Bello et al., 2004; Gao et al., 2015; Jimenez-Jimenez et al., 2019). Based on RBV, IT capability facilitates communication, knowledge management and data analysis tasks in innovation processes such as new product development (Ozer, 2000). Access to reliable and real-time information sharing, better organisational resources management and more accurate decision-making also enhance SCI capability (El-Kassar & Singh, 2019; Lin et al., 2010). According to the DC perspective, IT infrastructure flexibility helps to enhance a firm‘s dynamic capabilities, such as the capability to transform business methods at short notice to accommodate a changing environment (Leal-Millán et al., 2016). Consequently, this allows firms to innovate faster and more successfully than their competitors (Cheng et al., 2014).

❖ SCI antecedents at inter-organisational level

Inter-organisational factors are mainly classified into two main themes, dynamic capability building and relationship governance mechanisms, which have received a growing interest in SCI research. Resource/capabilities-based views, such as RBV, DCT, KBV and RDT, all highlight the impact of inter-firm strategic relationships, as characterised by the collaboration/integration among supply chain actors for SCI. According to RBV and DCT, innovation emphasises the role of complementary resource and co-specialisation (Barney, 1991; Teece, 2007; Teece & Pisano, 1994), which are often facilitated by dynamic capability-building processes such as collaboration, relationship learning or knowledge development in a supply chain or network of firms (e.g., Agarwal & Selen, 2013; Iddris et al., 2016; Jean et al., 2018; Shan et al., 2020). From the RDT perspective, when internal resources do not satisfy the organisational need, especially in the context of environmental uncertainties, firms usually seek complementary resources through interdependent relationships with other members of the supply chain in order to develop or enhance their own innovation capabilities (Lii, 2016). This area of research is at the forefront of the literature, accounting for nearly 50% of the reviewed articles.

Based on a combined RBV, DC and KBV perspective, knowledge is the core source of innovative activities that involve a transformation process of the firm‘s knowledge resources (Eisenhardt & Martin, 2000). In other words, innovation is closely linked to a process of knowledge development, knowledge exchange and their combination (Kodama, 2005). From this viewpoint, a vast research stream highlights the importance of learning and/or knowledge development activities (e.g., knowledge sharing, knowledge absorption, knowledge synthesis) for innovation (e.g., Grawe et al., 2011; Song et al., 2010).

Finally, TCT (Williamson, 1979) and SET (Emerson, 1976) explain that relationship governance mechanisms, used to safeguard inter-firm relationships, direct routines and enhance co-operation among related partners (Cai et al., 2009; Zheng et al., 2008), play an important role in SCI. In prior studies, both relational governance, such as trust (e.g., Panayides & Lun, 2009; Song et al., 2010; Wang, 2011), commitment (e.g., Bravo et al., 2017; Shin et al., 2019) and interdependence (e.g., Yeniyurt et al., 2014), and formal governance, such as contracts (e.g., Wang & Shin, 2015) and procedural justice (e.g., Bravo et al., 2017), were usually cited as factors influencing SCI. From an SET perspective, when there is honest and open communication and interdependence, firms are likely to provide their partners with timely and accurate information, and to make specific investment toward co-innovations (Yeniyurt et al., 2014). In short, governance mechanisms are crucial for SCI, ensuring smooth and efficient adoption across the supply chain

❖ SCI antecedents at environmental level

According to Institutional Theory, organisations usually engage in certain business practices based on the impacts generated by forces originating in external environments (Scott, 2004). In a highly competitive market, increasing institutional pressures are placed on organisations to adopt innovative practices to gain competitive advantage (Da Silveira, 2001). Indeed, previous research found that the decision by firms to adopt innovation is based on or affected by environmental pressures, such as environmental policy (Bag & Gupta, 2017; Zailani et al., 2015) and regulatory pressures (Oliveira et al., 2014). Firms operating in more regulated industries, for example, where strict environmental regulation exists, are more likely to adopt innovative activities, such as implementing environmentally friendly processes/technologies or considering green concepts for their products/services (Qi et al., 2010). Other environmental pressures, such as market demand (Zailani et al., 2015) and pressures from customers (Gualandris & Kalchschmidt, 2014), were also recognised as factors influencing SCI. For example, while it is necessary for firms to understand the operational and strategic implications of market demand (e.g. increasing demand for green products), these can drive them to adopt innovations so as to produce green products and meet the market demand (Zhou et al., 2005).

- To sum up, inter-organisational antecedents play the most important role in enabling innovation, reflecting an emphasis on strategic relationships between or joint learning among the supply chain partners, as well as on the governance mechanisms of their interactions. By contrast, less attention has been given to organisational and environmental antecedents. The literature also indicates that, whereas most of the previous research discusses driving/enabling factors of SCI, only a few articles were found to explore SCI barriers, such as cognitive barriers (e.g., different perceptions of relationships between supply chain members) (Skippari et al., 2017), using too much external knowledge (Thu et al., 2018), contracts that are too detailed (or insufficiently detailed) in partnership governance (Wang, 2011), relationship-specific investments (Wagner & Bode, 2014), regulatory pressures (Oliveira et al., 2014), asymmetric relationships in the supply chain (Lambrecht et al., 2015), lack of training and technical expertise, popularity of traditional technology, and fear of flexibility loss and extra workload (Gupta et al., 2020), as well as concern about the impact of technologies on the characteristics and retailing of products (Simms et al., 2020). It is also interesting to note that some antecedents (e.g., relationship-specific investment, asymmetric relationships, regulations and trust) have been identified as either drivers of or barriers to innovation, depending on the specific context in which the firm operates. For example, a higher level of trust does not lead to innovation in emerging markets, while it does in mature markets (Michalski et al., 2014). Therefore, the impacts of these factors on SCI should be re-examined. The list of the most cited antecedents at each of the three levels is summarised in Table 2.5.

Table 2.5: The most cited antecedents in each level

	Most widely accepted antecedents	Critical theories used	Represented previous research
Organisational factors	**Organisational capabilities**		
	○ IT capability, technological competence, technological diversity, IT infrastructure flexibility, IT adoption		○ Cheng et al. (2014), Gao et al. (2015), Iddris et al. (2016), Iliopoulos et al. (2012), Jimenez-Jimenez et al. (2019), Leal-Millán et al. (2016), Westergren and Holmström (2012)
	○ Human resource quality, top management commitment, employee motivation		○ Babalola et al. (2015), Bag and Gupta (2017), Burki et al. (2019)
	Organisational culture	**RBV, DCT**	
	○ Environmental ethics, corporate social responsibility, environmental compliance, internal environmental management, regulation awareness		○ Chinomona and Omoruyi (2016), El-Kassar and Singh (2019), Hasler et al. (2016), Lee et al. (2014), Seman et al. (2019), Tantayanubutr and Panjakajornsak (2017)
	○ Institutional orientation e.g., customer and competitor orientation		○ Cheng et al. (2014), Ho et al. (2018), Grawe et al. (2009), Jiménez-Zarco et al. (2011)
Inter-organisational factors	**Dynamic capabilities**		
	○ SC integration		○ Adebanjo et al. (2018), Ayoub et al. (2017), Baharanchi (2009), von Haartman and Bengtsson (2015), Lii and Kuo (2016), Ju et al. (2016), Nogueira Tomas et al. (2014), Wong et al. (2013), G.-C. Wu (2013)
	○ SC collaboration		○ Jajja et al. (2014), Haus-Reve et al. (2019), Iddris et al. (2016), Li et al. (2018), Luzzini et al. (2015), Macchion et al. (2017), Melander (2018), Singhry (2015), Soosay et al. (2008), Yunus (2018), Liao et al. (2021)
	○ SC coordination/cooperation	**RBV, KBV, DCT, RDT**	○ Mandal (2015), Tomlinson and Fai (2016)
	○ Customer and/or supplier integration/ involvement /cooperation/ collaboration		○ Bag and Gupta (2017), Cassivi et al. (2008), Ju et al. (2016), Hadaya and Cassivi (2009), Inemek (2013), Lee et al. (2014), Lin et al. (2010), Petersen (2005), Song and Di Benedetto (2008), Sun et al. (2010)
	○ Long-term partnership/strategic relationship/relationship embeddedness		○ Ju et al. (2016), Krolikowski and Yuan (2017), Lin et al. (2010), Zhang et al. (2018), Ramkumar (2020)
	○ Learning		○ Agarwal and Selen (2011), Agarwal and Selen (2013), Bryan Jean and Sinkovics (2010), Jean et al. (2012), Jean et al. (2018), Mylan et al. (2015), Leal-Millán et al. (2016), Lisi et al. (2019), Salunke et al. (2011), Song et al. (2010), Haq et al. (2020)
	○ Knowledge development, synthesis/ acquisition/ absorption /transfer/ sharing/ exchange		○ Chen (2018), Grawe et al. (2014), Grawe et al. (2011), Chowdhury et al. (2017), Liao and Barnes (2015), Linder and Sperber (2019), Nguyen and Harrison (2019), Sun (2013), Zhang et al. (2018), Westergren and Holmström (2012)
	Relationship Governance		
	○ Trust	**TCT, SET**	○ Bravo et al. (2017), Iddris et al. (2016), Mandal (2015), Mandal (2016a), Yeniyurt et al. (2014), Michalski et al. (2014) Panayides and Lun (2009), Song et al. (2010), Wang (2011)
	○ Commitment		○ Bravo et al. (2017), Mandal (2015), Mandal (2016a), Shin et al. (2019), Yeniyurt et al. (2014)
	○ Communication		○ Mandal (2015), Mandal (2016a)
	○ Reciprocity		○ Mandal (2016a), Nguyen et al. (2019)
	○ Power		○ Mandal (2016a), Pol and Visscher (2010)
	○ Contract		○ Bouncken (2011), Sumo et al. (2016), Wang (2011), Wang and Shin (2015)
	○ Procedural justice		○ Bravo et al. (2017)
Environmental factors	○ Environmental policy/regulations		○ Bag and Gupta (2017), Bello et al. (2004), Oliveira et al. (2014), Zailani et al. (2015)
	○ Stakeholder view, market demand, customer pressure	**Institutional theory**	○ El-Kassar and Singh (2019), Gualandris and Kalchschmidt (2014), Zailani et al. (2015)
	○ Environmental uncertainties (e.g., technological uncertainty)		○ Jean et al. (2012)

2.5.2.3 Consequences of SCI

As supported by RBV and DCT, the literature has highlighted the significant influence of SCI on both firm and supply chain performance, and stated that innovations enable firms to gain a competitive advantage, improve performance, and increase their adaptability to a changing environment. The impacts of SCI on firms can be classified into three dimensions: financial performance (i.e., growth in sales or profits, market share and return on investments) (Nguyen & Harrison, 2019; Piening & Salge, 2015), non-financial performance (i.e., profitability, competitiveness and customer satisfaction) (Chinomona & Omoruyi, 2016; Ho et al., 2018), and operational performance (i.e., cost, operational flexibility, operational responsiveness, operational service quality, dependability and accuracy) (Grawe et al., 2011; Ju et al., 2016).

When deploying innovations in the context of a supply chain, firms are usually required to integrate their supply chain partners into their innovative strategies and practices (Acar & Atadeniz, 2015; Kim, 2009). Hence, benefits for both parties – and even for all related stakeholders – can be achieved, leading to the improved performance of the entire supply chain. Accordingly, SCI can lead to improved supply chain performance, based on various aspects such as quality, cost, time to market, lead times, delivery reliability, level of inventory, and conformance to specification within the supply chain (Panayides & Lun, 2009). Some studies were found to emphasise specific aspects of supply chain performance, such as supply chain efficiency, flexibility and sustainability. Table 2.6 summarises the consequences of SCI on two levels. It is noted that the majority of the research linked innovation with firm performance, while much less effort was spent examining the impact of SCI on supply chain performance. In addition, as each study focused on different measures/indicators of supply chain performance, it is difficult to make generalisations about the impacts of innovation on performance across the supply chain.

Table 2.6: The consequences of SCI addressed in the literature

	Consequences of SCI	Represented previous research
Firm performance	○ **Financial performance** sales, profit, market share, return on investment	Jean et al. (2012), Piening and Salge (2015)
	○ **Operational performance** price/cost, quality, time, flexibility, operational responsiveness, operational service quality, dependability and accuracy	Richey et al. (2005), Grawe et al. (2011), Ju et al. (2016)
	○ **Market performance** profitability, market share, competitiveness, and customer satisfaction	Chinomona and Omoruyi (2016), Ho et al. (2018), Kibbeling et al. (2013)
	○ **Sustainable performance** economic and environmental performance	Shafique et al. (2017), El-Kassar and Singh (2019)
SC performance	○ **SC efficiency and effectiveness**	
	- **Overall SC performance:** quality improvement, cost reduction, time to market, lead times, delivery reliability, level of inventory and conformance to specification	Panayides and Lun (2009), Singhry (2015)
	- **SC efficiency:** response time, waste elimination, efficient information flow	Kalyar et al. (2019), Lee et al. (2011), Yoon et al. (2016)
	- **SC competency:** quality, service, operation, distribution, and design effectiveness	Bravo et al. (2017)
	○ **SC flexibility**	
	- **SC agility:** capability of forecasting market demand, responsiveness to changing market demand, integration with suppliers/customers, visible inventory, reliable delivery	Iddris et al. (2016), Kim and Chai (2017)
	- **SC resilience:** ability to respond quickly and recover from disruptions and unexpected events	Golgeci and Y. Ponomarov (2013), Kwak et al. (2018), Afraz et al. (2021)
	○ **SC sustainability** economics, social and environmental performance	Gualandris and Kalchschmidt (2014), Zailani et al. (2015), Kabadurmus (2020), Zhang et al. (2021), Krishnan et al. (2020)

2.5.3 Integrated multi-dimensional framework of SCI – Dimensions, antecedents and consequences

Synthesising the categorical analysis, this section integrates the findings into a multi-dimensional framework on SCI (see Figure 2.13). The typology of SCI that emerges from the relevant literature is organised into degrees, types and scope of SCI. The critical antecedents of SCI are consolidated according to three different levels: organisational, inter-organisational and environmental. Finally, the consequences of SCI show the relationship between SCI and its impact on two levels, namely, firm and supply chain performance. This framework can be used as a practical tool for both practitioners and scholars to identify the dimensions of SCI, and it measures for the antecedents and consequences in each of the SCI categories.

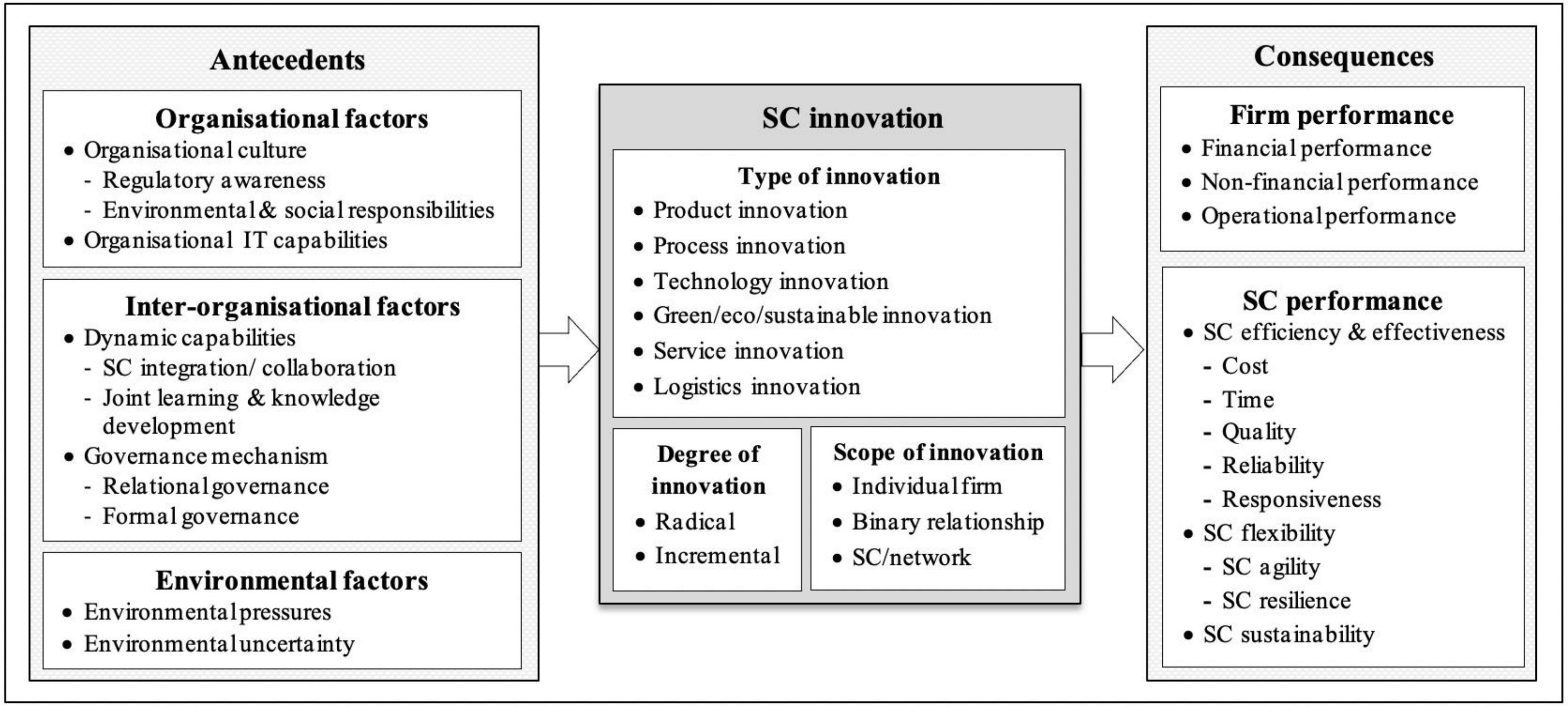

Figure 2.14: A framework for antecedents and consequences of SCI based on a synthesised literature review

2.5.4 Identified gaps in research and directions for further study

Having developed the integrated framework of SCI, its antecedents and consequences, the next central purpose of this review is to identify research gaps and directions for future study. The following lists some observations on both areas.

- ❖ Gap 1 – related to the methodological aspects

The systematic literature review findings indicated that the survey method has been used predominantly in research (78% of the reviewed articles) to confirm causal relationships between SCI and its antecedents/consequences. Thus, for deeper and more insightful results, case studies or mixed methods are recommended for this research topic. As noted in this review, the majority of past research has focused on manufacturing and/or service, while minimal attention has been given to other sectors (see Section 2.5.1.2). Thus, there is a strong need to investigate the influential factors of innovation for sectors that have received less focus, such as agriculture and IT.

- ❖ Gaps 2– related to dimensions of SCI toward a complete SCI

Although a large of number of prior studies have explored the antecedents/consequences of innovation, most of the research was conducted in the context of an individual firm or a binary relationship (e.g., Azadegan & Dooley, 2010; Gölgeci & Ponomarov, 2015; Kim & Chai, 2017; Krolikowski & Yuan, 2017; Panayides & Lun, 2009; Salunke et al., 2011; Song et al., 2020). As SCI is a complex process in which different stakeholders along the entire value chain play different roles, the scope of SCI must be extended to a connected supply chain. The supply chain that seeks to improve its performance through innovations needs to implement innovation practices across key supply chain actors (Storer et al., 2014). Thus, SCI in a supply chain context that covers core functions and involves all related stakeholders in the supply chain is worth examining. In addition, past studies almost all focused on a particular type of innovation, such as product innovation (e.g., Jajja et al., 2014; Liao & Barnes, 2015; Thu et al., 2018), process innovation (or a combination of product and process innovation) (e.g., Lisi et al., 2019; Sabri et al., 2018; G.-C. Wu, 2013) or technological innovation (e.g., Babalola et al., 2015; Lee et al., 2014; Linton, 2018). Future research in this area therefore should include coverage of the multiple types of innovation towards a comprehensive SCI, as well as exploring other types of innovation, identified in the literature but missing in this review, such as administrative, marketing and resource allocation innovations (Gao et al., 2017). Several more recent studies sought to fill these gaps by examining the combination of multiple types of innovation. For example, Seman et al. (2019) explored green innovation as underpinning a combination of product, process, marketing and managerial innovation, and Shan et al. (2020) collectively investigated technology, management and market innovation.

❖ Gaps 3– related to antecedents of SCI

It is clear from the findings that the literature favours investigation of the facilitators/enablers of SCI, whereas only a few studies sought to explore factors inhibiting innovation (e.g., Gupta et al., 2020; Simms et al., 2020; Skippari et al., 2017; Wagner & Bode, 2014). This indicates a wide gap for examination of the barriers that impact SCI. In addition, despite the large quantity of studies that have focused on some common influencing factors of SCI, the relevant literature is still relatively fragmented. There has been a lack of consensus on some factors, as well as inconsistent conclusions (see Section 2.5.2.2). This signals a need to re-visit these factors.

❖ Gap 4 – related to the consequences of SCI

Much of the SCI research has centred on the impacts of innovation on a firm's performance (Chinomona & Omoruyi, 2016; Ju et al., 2016; Nguyen & Harrison, 2019; Piening & Salge, 2015). While a few studies have sought to link innovation to different aspects of the supply chain, these studies evaluated supply chain performance based on a dyadic analysis (e.g., manufacturer and supplier) and survey method (e.g., Kalyar et al., 2019; Kwak et al., 2018; Panayides & Lun, 2009; Zhang et al., 2021). Therefore, researchers need to involve multiple actors/functions in the process, in order to determine the possible outcomes of innovation at the supply chain level. An investigation addressing how innovation creates value, or exploring more complex patterns of innovation outcomes using the triangulation of data, would be a significant contribution to the field. Furthermore, it is suggested that future research explore possible moderators of SCI-SCP linkage, which appears to be an unexplored area.

❖ Gap 5 – related to theoretical perspectives

The findings indicate that over half of the reviewed studies lacked theoretical underpinnings in explaining the relationships between SCI and its antecedents/consequences. Thus, there is a promising avenue for connecting SCI study with existing theories that have been studied less or omitted in the literature. SCI also calls for an integration of various theoretical perspectives, such as RBV, DC and TCT, in investigating particular antecedents of SCI; this is another potential area for future research.

2.6 Review of critical antecedents and consequences of SCI and assessment of related previous research

This section provides a brief review of critical antecedents and consequences of SCI, which are the constructs of the conceptual model developed in Chapter 3. Drawing on Transaction Cost Theory (Coase, 1937; Williamson, 1985), and Dynamic Capability Theory (Teece et al., 1997), the study aims to explore the impact of Contract, Trust, SCC and SCL on SCI, as well as the link between SCI and SCP, moderated by ENU. These factors are also considered based on the identified gaps in the literature and on the characteristics of Vietnam‘s agricultural supply chain. First, as evident from the literature review conducted in the previous section (see Section 2.5), these factors have been unexplored or less studied, or they lack consensus based on previous research, or have been investigated in the context of individual firms/a particular type of innovation. Second, these factors are not only suitable but critical for investigating Vietnam‘s agricultural supply chain, which has revealed the need for effective governance, learning mechanisms and collaboration across the chain, to achieve effectiveness and success of innovation in the supply chain, as analysed in Section 2.4.2.

2.6.1 Brief review of critical antecedents and consequences

2.6.1.1 Governance mechanism – Contract and Trust

Governance mechanism has been widely accepted as imperative for governing and safeguarding supply chain relationships. An effective governance structure enables firms to achieve a win-win relationship with their partners, and achieve competitive advantages by managing opportunistic behaviours in exchanges (Cai et al., 2009; Zheng et al., 2008). The literature has separated governance mechanism into two dimensions, formal governance (e.g., legal bonds, formal contracts, economic incentive systems) and relational governance (e.g., trust, goodwill and embeddedness) (Ness & Haugland, 2005; Poppo & Zenger, 2002). In this regard, this study examined the impact of

Contract and Trust, which are representative of the two dimensions of governance, respectively.

Contract is ―the extent to which detailed and binding contractual agreements are used to specify the roles and obligations of the parties" (Cannon et al., 2000, p. 182). It is also defined as written agreements between business partners that provide legally binding frameworks in which each partner‗s responsibilities, duties and rights are specified (Luo, 2002). Contract plays a vital role in supply chain relationships (Liu, Luo, et al., 2009) as it prescribes appropriate behaviours of partners in the supply chain, along with their obligations and expectations in terms of, e.g., routines for outcome distribution or sanctions for violating agreements (Carey & Lawson, 2011; Wuyts & Geyskens, 2005).

Trust is defined as the willingness to rely on an exchange partner in whom one has confidence (Moorman et al., 1993). Trust involves the decision of an actor to rely on their partner, with the expectation that the partner will act in accordance with the defined agreements (Inkpen & Currall, 2004). The principle characteristics of trust include the honesty of the partners and the belief that all involved partners are interested in collaborative effort success (Anderson & Narus, 1990). In the SCM context, trust is viewed as a key contributor to long-term and sustainable supply chain relationships (Yeung et al., 2009). Trustworthy relationships in a supply chain can facilitate integration (Li et al., 2007) or cooperation within the supply chain (Yeung et al., 2009).

2.6.1.2 Supply chain collaboration

SCC is defined as the formation of close and long-term partnerships through which supply chain partners work together and share information, resources and risks to attain mutual goals (Bowersox et al., 2003). In a collaborative relationship, two or multiple independent firms jointly plan and execute the supply chain operations and activities to achieve greater success than when they act in isolation (Simatupang & Sridharan, 2005). Cao and Zhang (2011) identified interconnecting components of SCC, including information sharing, resource sharing, collaborative communication, goal congruence, decision synchronisation, joint knowledge creation and incentive alignment.

SCC brings firms a number of benefits such as costs and inventory reduction, better utilisation of transport capacity, increased responsiveness, improved customer service, and more timely and accurate information in the supply chain (Mentzer et al., 2001;

Simatupang & Sridharan, 2005). In particular, SCC helps to reduce rationing and gaming, consequently eliminating the bullwhip effect in the supply chain (Holweg et al., 2005), which is –the phenomenon of demand variability amplification along a supply chain, from the retailers, distributors, manufacturer, and the manufacturers‘ suppliers, and so on" (Lee et al., 2000, p. 626).

2.6.1.3 Supply chain learning

Learning refers to the accumulation of knowledge, along with the understanding of potential benefits (Nonaka, 1991) that may change the behaviours of individuals or organisations (Slater & Narver, 1995). The learning process involves continuous interpretation and assimilation of information to create new knowledge, which can be used to develop innovative processes for attaining organisational objectives (Ojha et al., 2016). SCL is developed based on the concept of inter-organisational learning, which is the extent to which knowledge (information and know-how) is shared and transferred between firms, such as buyers and sellers (Danny et al., 2003). In this regard, SCL occurs when two or more firms within a supply chain interact to jointly deal with logistics and supply chain problems (Flint et al., 2005). It is also defined as the process of –ensuring that one‘s own firm as well as their suppliers and customers are actively managing the learning process aimed at supply chain management issues” (Flint et al., 2008, p. 264).

In the context of the supply chain, learning can be stimulated through discussion or debates in group meetings, conferences, workshops, journals or platforms (virtual community) and collective bodies (e.g., industry associations) that act as facilitators to bring supply chain actors together (Flint et al., 2008; Mylan et al., 2015). Learning may involve information and knowledge about the market (e.g., consumer preference), technology (e.g., applications, costs and performance) and/or employees‘ skills and experience (Argote & Ingram, 2000; Mylan et al., 2015). A simple example of SCL is firms engaging in discussions with their key customers and suppliers through face-to-face meetings, to find better ways to serve each other and end-consumers (Esper et al., 2010). This enables firms to effectively meet their customers‘ demands and/or suppliers‘ activities; by this means, firms are able to modify their organisational processes or products/services accordingly, enabling them to be more likely to satisfy their partners‘ expectations (Flint et al., 2008).

2.6.1.4 Supply chain performance

There are various indicators recommended for measuring SCP in the literature (Folan & Browne, 2005). Few attempts have been made to establish or minimise a set of indicators or SCP measures. For example, according to Hult et al. (2006). SCP can be measured based on quality, speed, cost and flexibility. The extant literature also suggests key empirically tested parameters of SCP, including quality improvement, cost reduction, time to market, lead times, delivery reliability and level of inventory (Narasimhan & Das, 2001; Shah, 2009; Shin et al., 2000; Tan et al., 2002). Ambe (2014) consolidated a list of key SCP indicators, as shown in Table 2.7.

Table 2.7: Key SCP indicators

Attributes	Key SCP indicators
Quality	○ Meeting quality performance standards ○ Defect detected per unit produced per unit purchased ○ Quality awards standards ○ Products per unit sold ○ Fitness of use
Flexibility	○ Supply chain response time ○ Production flexibility
Cost	○ Cost measures within the organisation ○ Total supply chain management cost (across the supply chain)
Supplier reliability	○ Effectiveness of suppliers ○ Identification of suppliers ○ Improve supplier communication ○ Improved supplier risk management
Innovation	○ Annual investment in research and development ○ Radical and incremental changes
Responsiveness	○ Order fulfilment lead time
Order delivery lead time	○ Fulfilment of orders on time ○ Damage-free delivery ○ Complete delivery as required ○ Delivery meets customers' requirements
Product delivery reliability	○ Delivery performance ○ Fill rates ○ Perfect order fulfillment
Asset management	○ Cash-to-cash cycle time ○ Inventory days of supply ○ Asset turns

Source: *Ambe (2014)*

2.6.1.5 Environmental uncertainties

ENU is the level of instability and the rate of changes in the environment (Dess & Beard, 1984), covering three main dimensions: technology uncertainty (e.g., complexity, rapid changes and unpredictable development of technologies), demand uncertainty (e.g., variations in market demand and customer preferences), and supply uncertainty (e.g., fluctuations in timeliness and quality of material supply) (Badri et al., 2000; Chen & Paulraj, 2004). ENU affects the ability of a firm to understand and predict how the environment might change and how to deal with such changes (Wang et al., 2011). Thus, firms need to significantly and continuously monitor industrial conditions in order to acquire reliable and accurate information, along with adjusting/changing their strategies to react to threats and risks of uncertainties (Krishnan et al., 2006). Following previous research (e.g., Fynes et al., 2004; Land et al., 2012; Lynn & Akgün, 1998), together with the consideration of the research context of the agricultural supply chain, this study focused on examining the impacts of demand and technology uncertainties on the link between SCI and SCP.

2.6.2 Assessment of prior research – towards the novelty of this study

Following the review of the literature relating to the above factors, this study aimed to assess all the relevant past research on how the factors have been previously investigated, and one prior findings about their relationships with SCI. This helps to identify and fill the research gaps, leading to this study's novelty and contributions. Table 2.8 lists the previous studies related to the focus of this study.

Table 2.8: The comparison between this study and other related research

Constructs	Related previous research	Findings	Method used	Sector of focus	The newness of this study
Contract & Innovation	Wang et al. (2011)	Contract positively affects firm's innovative performance Yet too little or too detailed contract hinder firm's innovativeness	Survey	Manufacturing	investigating the impact of contract on a complete SCI
	Wang and Shin (2015)	Revenue-sharing contract enhance supplier's innovation investment while wholesale price contract and quality dependent wholesale price contract result in underinvestment in innovation	Survey	Manufacturing	
	Sumo et al. (2016)	Performance-based contract fosters radical and incremental innovation in buyer-supplier relationship	Survey	Multiple sectors	
Trust & Innovation	Panayides & Lun (2009)	Trust impacts on innovativeness (in manufacturer–supplier relationship)	Survey	Manufacturing	Investigating direct impact of trust on SCI, covering product, process and technology innovation
	Song et al. (2010)	Trust enhances firms' innovativeness but through joint problem solving			
	Wang et al (2011)	Trust positively affects firm's innovative performance	Survey	Manufacturing	The relationship between trust and SCI is mediated by SCC
	Westergren & Holmström (2012)	Trust enables open innovation			
	Yeniyurt et al. (2014)	Trust has positive impact on product innovation	Survey	Automobile	
	Michalski et al. (2014)	Trust leads to IT innovation	Survey	Multiple sectors	
	Mandal (2015)	Trust impacts on SCI	Survey	Logistics	
	Bravo (2017)	Trust increases orientation to open innovation	Survey	Manufacturing & service	
SCC & Innovation	Soosay et al. (2008	SCC promotes radical and incremental innovation	Case studies	Logistics	Examining impact of SCC on SCI, covering product, process, & technology innovation, using mixed method of case study and survey Underlining the mediating role of SCC
	Wagner (2010)	Supplier collaboration has impact on product innovation	Survey	Multiple sectors	
	Jajja et al. (2014)	Supplier-buyer collaboration impact on product innovation	Survey	Multiple sectors	
	Yunnus (2018)	SCC influences radical and incremental innovation	Survey	Multiple sectors	
	Melander (2018)	Customer and supplier collaboration are important to green product innovation	Case studies	Manufacturing and service	
	Hofman et al. (2020)	Customer and supplier collaboration enhance eco-innovation	Survey	Manufacturing	
SCL & innovation	Flint et al. (2008)	SCL has positive impact on firm's innovation management	Survey	Logistics	Investigating relationship between SCL and SCI that cover product, process, & technology innovation, in supply chain context
	Lisi et al. (2019)	SCL positively influences green product and process innovation	Survey	Multiple sectors	
	Hag et al. (2020)	SCL promotes innovation performance			
SCI & SCP	Panayides & Lun (2009	Innovativeness improves SCP, analysed based on manufacturer-supplier relationships	Survey	Manufacturing	Examining impact of a complete SCI on SCP, involving different stages of the supply chain
Moderating role of EU	Mandal (2016b)	Environmental uncertainty the positively moderating the link between SCI and firm performance	Survey	Multiple sectors	Examining the moderating role of EU on SCI- SCP link

Note: *the blue elements highlighted in the table are the emphases of the comparison.*

As clearly shown in Table 2.8, this study can be considered a novel investigation of these relational constructs in terms of the different aspects discussed subsequently. In addition, the examination of an integrated framework of the underlying constructs, in the context of the agricultural supply chain in a developing country such as Vietnam, is new and unique in the extant literature. The following constitute this study's novelty.

- First, although the impact of Trust on innovation has been demonstrated in prior studies, their focus was on one particular type of innovation (product or technology innovation), or on another perspective of innovation, such as innovative performance and orientation to innovation. Also, most of the previous research was conducted in the context of an individual firm or binary relationship. Moreover, previous studies have produced inconsistent conclusions on the relationship between trust and innovation. In particular, while most of the prior research indicated the importance of Trust for innovation, Michalski et al. (2014), exceptionally, found that Trust enables innovation only in mature markets, and not in emerging markets. Thus, it is worth investigating the role of trust in an emerging market such as Vietnam.
- There has been no prior research examining the impact of Contract on SCI, in terms of the innovation approach as product, process and technological innovation. Only one research study was found to examine the role of Contract in radical and incremental innovation; the other two studies linked Contract with a firm's innovative performance and orientation to innovation. Also, according to Wang et al. (2011), the use of Contract does not always promote innovation. In particular, an insufficiently or overly detailed contract can hinder a firm's innovativeness. Thus, this factor should be further assessed.
- Some previous research has addressed the relationship between collaboration and incremental/radical innovation, or product innovation rather than SCI. This study therefore aimed to fill this gap, and to conduct the first investigation of the relationship between SCC and SCI, with an emphasis on the mediating role of SCC in the relationship between Trust, Contract and SCI.
- Although very few past studies were found to explore the influence of SCL on innovation, these studies have linked the influence of SCL to a firm's innovation management, or innovation performance, or green innovation. In this regard, this study is the first to examine the impact of SCL on SCI.

- While previous studies were more likely to focus on the relationship between SCI and a firm's performance, the impact of SCI on SCP has been less well investigated. In addition, there has been no research investigating the SCI-SCP link moderated by ENU. Hence, this study filled this gap to make novel contribution to the literature.

2.7 Summary

In this chapter, a comprehensive literature review on this research topic has been conducted. All related concepts/perspectives have been included, starting from innovation, supply chain management and the convergence of them towards SCI. Following this, an assessment of the agricultural supply chain in general and in Vietnam in particular has been provided, underlining the distinctive characteristics, current challenges and issues of the supply chains. The primary importance of this chapter is the systematic review of previous research, which has helped to synthesise current knowledge and develop an integrated framework of SCI, its dimensions, antecedents and consequences. The findings identified some major research gaps and set directions for the focus of this study towards the research model. To this end, this study provided a review of each of the model's constructs, and an intensive assessment of all the relevant past studies which examined any of the underlying constructs. Figure 2.14, presenting research gaps and how this study fulfils these gaps, closes this chapter.

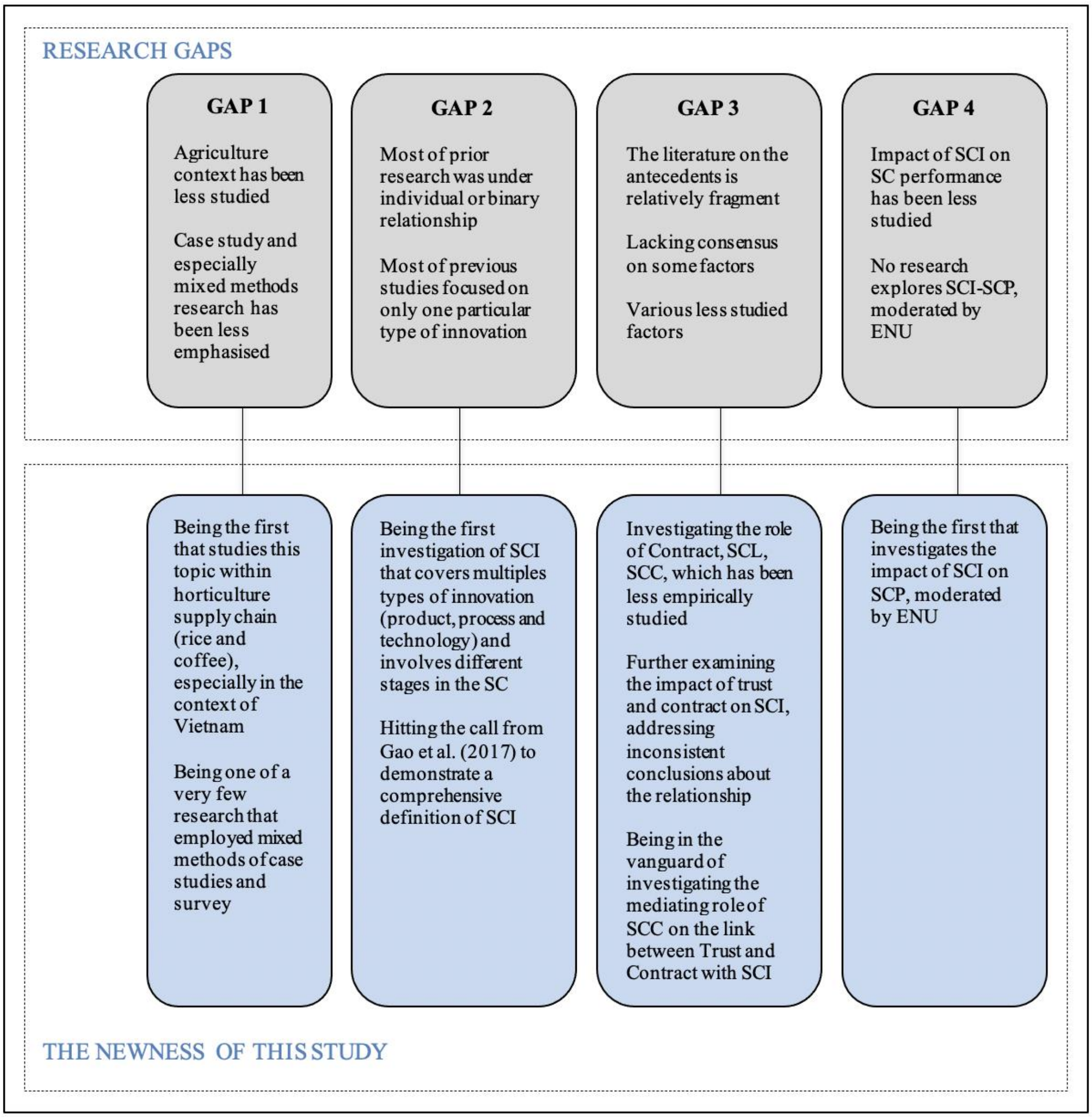

Figure 2.15: Illustration of the extent to which the study fills the research gaps

Chapter 3: THEORETICAL GROUNDING AND HYPOTHESES DEVELOPMENT

3.1 Introduction

This chapter first reviews the Transaction Cost and Dynamic Capability theories, which underpin the hypothesised relationships in the conceptual model (Section 3.2). In this section, the development, theoretical meaning and importance of the theories are first reviewed and assessed, then the justification for use of these theories in this study is outlined. the research hypotheses are then developed, in conjunction with the application of the two theories, in Section 3.3. Lastly, the integrated research model is formulated and presented in Section 3.4. The outline of Chapter 3 is depicted in Figure 3.1.

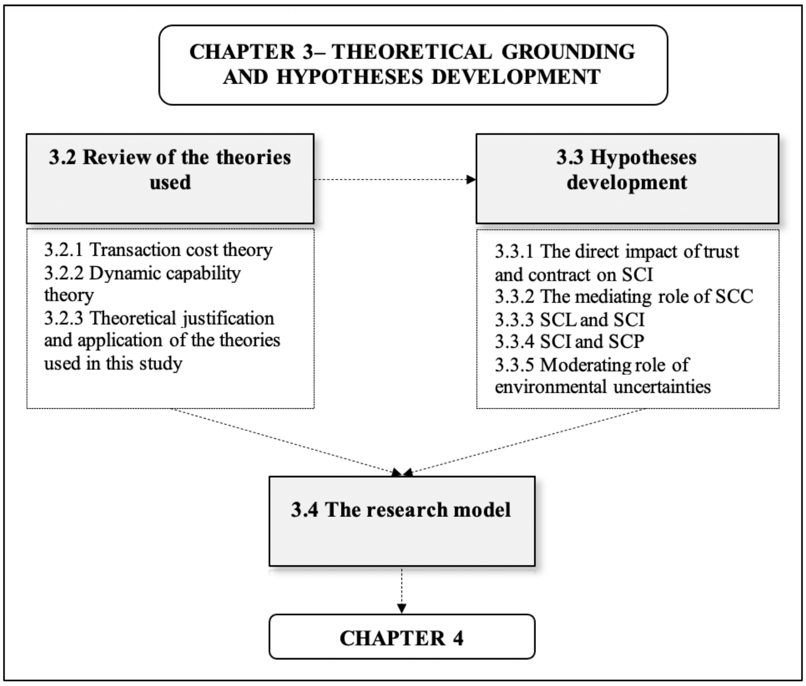

Figure 3.1: The outline of chapter 2

3.2 The review of the theories used in this study

In this study, Transaction Cost Theory (TCT) and Dynamic Capability Theory (DCT) were used as the theoretical grounding for the proposed relationships between SCI, its antecedents and its consequences. A brief review of the theories is provided next, followed by the justification of the application of the theories in this study.

3.2.1 Transaction Cost Theory (TCT)

TCT was originally developed by Coase (1937) and then further developed in a series of Williamson‘s seminal works (e.g.,Williamson, 1979, 1981, 1985, 2005, 2008, 2010). TCT uses the concept of transaction costs to explain the existence and boundaries of firms (Williamson, 2008). Transaction costs refer to the costs of creating, using, altering, maintaining and governing the economic activities of firms. These can be divided into three different categories: political (e.g., legal), managerial (e.g., administration, monitoring performance), and market (e.g., information gathering, negotiating, writing contracts) (Furubotn & Richter, 2010). The key cost-determining attributes of a transaction include uncertainty (i.e., environmental and behavioural uncertainty), frequency (i.e., the rate of transaction re-occurrence) and asset specificity (i.e., the transferability level of assets such as resources, technology and know-how advantages) (Williamson, 1979).

TCT focuses on governance skills/forms to explain the organisation of economic activities of firms (McIvor, 2009). The theory is usually used as a theoretical framework for explaining why partnering firms exist, and it addresses the principles of ―sharing the pie" (Williamson, 1979). The basic assumptions of TCT are the bounded rationality and opportunistic behaviour of each partner in a transaction (Williamson, 1985). As individuals have limited capabilities to obtain, process and evaluate information (Grover & Malhotra, 2003), they are subject to bounded rationality (e.g., language, judgment or neurophysiological limits), which is viewed as a source of transaction costs. For instance, bounded rationality obliges the parties in a transaction to engage in ongoing negotiations on prices and specifications. Opportunistic behaviour refers to situations where individuals lie, cheat or engage in subtle violations of agreements in order to further or boost their own interests (Williamson, 1985). Opportunistic behaviour can increase transaction costs in the form of safeguarding assets or monitoring behaviours to prevent opportunistic conduct between partners. For example, suppliers may deliver inferior products if they believe that their buyers cannot detect the difference. This opportunistic behaviour may result in costs of quality checking of delivered products, or of monitoring outsourced production processes (Vieira et al., 2011).

There have been some criticisms of TCT in the literature. For instance, classic TCT almost always focuses on analysing economic issues, thereby neglecting social relationships (Martinez & Dacin, 1999), or not explaining a firm‘s behaviours from a knowledge-based view (Blomqvist et al., 2002). In addition, TCT was tested and developed under a set of limited assumptions, regardless of the potential impacts of a governance structure, existing portfolio, or specific firm asset on a certain transaction (Leiblein & Miller, 2003). However, the theory is considered flexible enough to be combined with other theories for a better application of TCT in considering social relationships (Williamson, 2005). Typically, DCT, which explains how a firm modifies, combines and integrates its external resources (Teece et al., 1997), can be used as complementary to TCT.

TCT provides a theoretical framework for evaluating and understanding a wide range of supply chain decisions and issues. For example, the theory has been used to explain the decision-making process of sourcing in a supply chain (outsourcing or using in-house operations) (Shelanski & Klein, 1995), and to examine supply chain efficiency and performance (Grover & Malhotra, 2003; Nyaga et al., 2010). In particular, TCT has been considered as a primary theory to explore inter-firm relationships, such as supply chain collaboration (Wilding & Humphries, 2006), and the governance structure of relationships (Wacker et al., 2016; Williamson, 2008).

3.2.2 Dynamic Capability Theory (DCT)

The literature distinguishes two categories of a firm‘s capabilities: operational and dynamic capabilities (O‘Reilly & Tushman, 2008; Zollo & Winter, 2002). While operational capabilities include a set of routines by which a firm organises its activities in relation to a specific outcome, dynamic capabilities refer to a set of routines integrating and extending a firm‘s resources and capabilities (Winter, 2003; Zollo & Winter, 2002). Here, routines can be viewed as repetitive and regular patterns of a firm‘s activities through which work is performed (Zollo & Winter, 2002).

Dynamic capability (DC) has emerged as a vital topic and attracted much attention from both academics and practitioners since the early 1990s (Teece & Pisano, 1994; Teece et al., 1997). DC can be best understood as ‒the firm‘s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments‘ (Teece et al., 1997, p. 516). DC is a primary source of a firm‘s competitive advantages (Teece et al., 1997), achieved through a process of attaining, integrating and reconfiguring resources, and especially through releasing the resources for a new resource configuration (Eisenhardt & Martin, 2000). DCs can be categorised into three different clusters: sensing (identifying and evaluating opportunities), seizing (mobilising resources to address the opportunities and seize value from doing so), and reconfiguring (continued resource renewal) (Teece, 2007). Teece and Pisano (1994) also suggested three core practices of building dynamic capabilities: *integration* (how firms coordinate and integrate their activities), *learning* (a process through which experimentation and repetition enable work to be undertaken more quickly and effectively as new opportunities are identified), and *reconfiguration* (the way in which firms reconfigure their asset structures and accomplish necessary internal and external transformations).

DCT evolved from Resource based view (RBV) (Bowman & Ambrosini, 2003). RBV is based on the idea that when a firm‘s resources are rare, valuable, inimitable and non-substitutable, they can achieve competitiveness for the firm (Barney, 1991). DCT is an extension of RBV in that it fills RBV‘s shortcomings. To explain, RBV generally focuses on firms‘ existing resources (Barney, 1991) and may neglect the effects of changing environments, such as rapid changes to a market and how firms, in turn, react to those changes (Zollo & Winter, 2002). DC involves a transformation process of firms‘ knowledge resources and routines to produce new and enhanced configurations of those resource and routines that allow them to respond quickly to a changing environment (Eisenhardt & Martin, 2000). In addition, whereas RBV mostly centres on resource identification and selection, DC addresses resource integration and capability-building processes (Helfat & Peteraf, 2003).

In short, DCT is a theoretical lens for explaining how firms use their DC, based on their ability to adapt, integrate and reconfigure their resource base to positively and quickly respond to environmental uncertainties, thereby facilitating new value creations and enhancing their competitive advantages (Eisenhardt & Martin, 2000; Teece, 2007;

Teece et al., 1997). In SCM, DCT has been used as a framework to explain how supply chain actors modify and integrate their internal and external resources to facilitate supply chain activities or improve supply chain performance. In particular, the theory is commonly applied in research that investigates SC re-configurability (Wei & Wang, 2010), sustainable SCM (Beske, 2012), global supply chain success (Reuter et al., 2010), supply chain integration, cooperation and/or collaboration (Chang, 2011; Kang & Moon, 2016), and supply chain resilience (Chowdhury et al., 2017).

3.2.3 Theoretical justification and application of the theories to this study

As indicated previously, both TCT and DCT have been widely used as important theoretical lenses for evaluating various problems/areas in SCM. Specifically, TCT has been frequently discussed in relation to inter-firm relationships and governance structures of those relationships (Williamson, 2008). The application of the theory therefore fits well with the aims and nature of the research problem in this study, which aims explore the impacts of SCC and supply chain governance mechanism (represented by Trust and Contract) on SCI. There have also been increasing contributions of TCT in the inter-firm innovation literature (Remneland- Wikhamn & Knights, 2012). The theory is often used as normative guidance for inter-firm innovation works (La Falce et al., 2014). Chesbrough et al. (2006) identified four dimensions of open innovation. One of these focuses on firms' transactions with their innovation partners in a way that is closely associated with TCT. Indeed, innovation has increasingly been a collaborative process in which firms often open up their innovation processes to facilitate knowledge exchange among them (Chesbrough, 2003). From the transaction cost perspective, the risk of opportunism by partners can endanger these collaborative efforts and increase coordination costs, such as evaluation and monitoring costs, and costs of facilitating ongoing tasks and activities among partners (Hannan & Freeman, 1984; Remneland-Wikhamn & Knights, 2012). TCT is therefore a critical theoretical framework for the assessment of co-innovation processes in the supply chain, guided by the control mechanism and collaboration. TCT is also a suitable theoretical lens to examine the moderating role of ENU, which is associated with risks of opportunism and increased transaction costs caused by a changing and unpredictable business environment (Srinivasan et al., 2011). Several previous studies highlight TCT as a sound theoretical lens to use for building on the SCI literature (e.g., Shafique et al., 2017; Sumo et al., 2016; Wang, 2011).

As TCT almost always explains interaction between partners from an economic perspective (e.g., transaction costs) (Blomqvist et al., 2002), the theory is recommended to be used in combination with others addressing social exchanges (Williamson, 2005), in order to provide a more comprehensive explanation of inter-firm relationships and their governance. In this aspect, DCT can be used as complementary to TCT to fully explain the role of SCC in SCI. Collaboration not only helps to reduce transaction costs in a relationship, but also enables firms to increase their ability to extend and integrate their external resources through collaborative practices with their supply chain partners: termed the dynamic capabilities of firms (Teece et al., 1997). Dynamic capabilities also evolve based on routines that are shaped by learning mechanisms (Teece & Pisano, 1994), in which knowledge is the most strategic resource and the basis of firms‘ competitiveness (Kogut & Zander, 1992). This indicates that DCT is an important theoretical lens for explaining SCL, which relies on knowledge creation, sharing and transfer between firms.

Dynamic capabilities come to the forefront in an uncertain environment (Eisenhardt & Martin, 2000). In relation to the uncertainty perspective, supply chain relationships cannot avoid substantial levels of uncertainty in the behaviour of related stakeholders, such as suppliers‘ conformity of delivery and product quality (Lawler, 2001). SCI is also considered to be associated with uncertainties because it is usually triggered by a firm‘s dynamic interaction with its business environment (Arlbjørn et al., 2011). On the one hand, one of the major themes of dynamic capabilities is that they are usually associated with *changes* (Eisenhardt & Martin, 2000). However, innovation is defined as *changes* to various aspects within and outside firms, such as a new source of supply, a new method of manufacturing, or a new market (Schumpeter, 1982), that help to reconfigure and extend their existing resources and capabilities. In this regard, dynamic capability perspectives are considered integral to the understanding of innovation, especially in the context of an uncertain environment such as the Vietnamese agriculture supply chain, with its limitations and challenges. Prior research also supported the soundness of using DCT in SCI investigations (e.g., Agarwal & Selen, 2013; Ju et al., 2016; Singhry, 2015).

In this study, TCT was used to explain the relationships between Trust, Contract and SCC, and their impacts on SCI, as well as the moderating role of environmental uncertainties. DCT was utilised to understand the link between SCL and SCI, and the impacts of SCI on the SCP. The research framework and the application of the selected theories in this study are depicted as Figure 3.2.

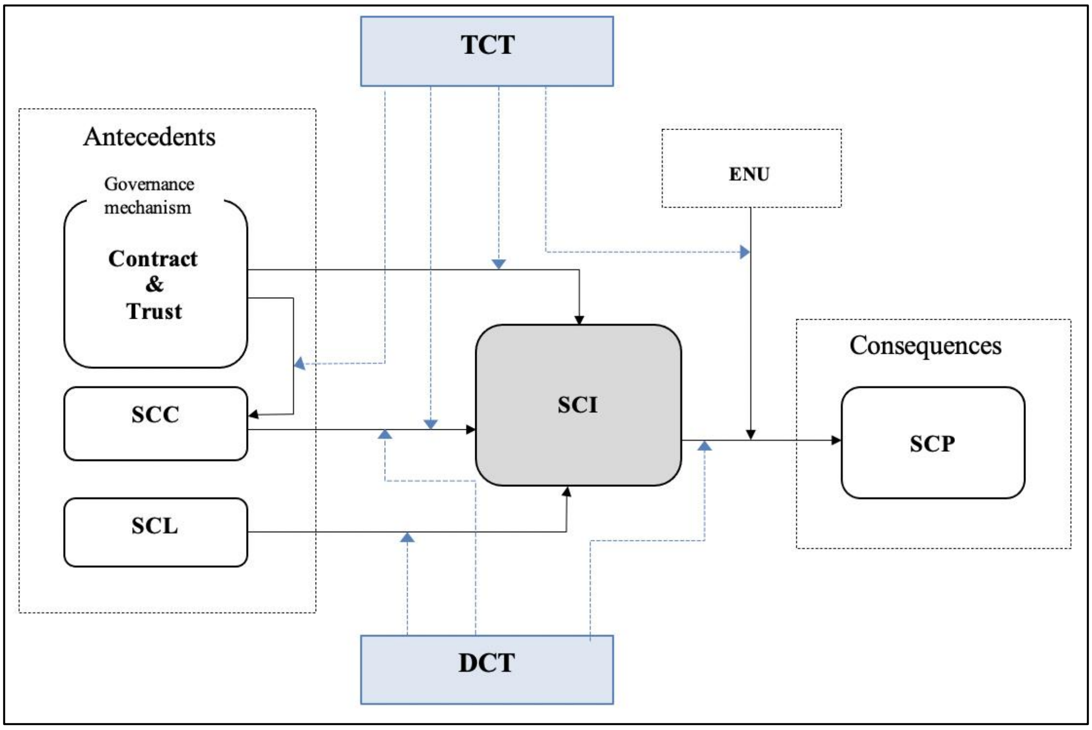

Figure 3.2: The study's theoretical framework in conjunction with the application of the theories used

3.3 Hypotheses development

3.3.1 The direct impact of Governance mechanism, in particular Contract and Trust, on SCI

3.3.1.1 Contract and SCI

From the TCT perspective, when the characteristics of transactions are not addressed, or are insufficiently addressed, this may cause opportunistic behaviour by related exchange partners (Williamson, 1979). This risk can be mitigated by the use of contract, which is a key mechanism to control opportunistic behaviours, and an incentive structure for aligning the interests of different stakeholders (Luo, 2002; Makri et al., 2006). As a result, in a contractual relationship characterised by minimised opportunism and lower transaction costs, partners have incentives for co-value creation and joint value maximisation, such as co-adopting innovative practices (Cao & Lumineau, 2015; Li et al., 2010; Morgan et al., 2007; Whang, 1993), which in turn enhances their innovation capabilities. In addition to this, when desired outcomes and rewards are specified in the contract, stakeholders are more willing to adopt innovations (Argyres & Mayer, 2007). A contractual relationship can also induce the partners to invest in co-innovation activities in order to achieve mutual benefits and avoid associated switching costs (Krolikowski & Yuan, 2017). This not only facilitates innovation but also enhances the efficiency of innovation.

Contract may facilitate a combination of complementary strategic resources and relationship-specific investments (Wacker et al., 2016), resulting in the concentration and coordination of resources for innovative activities. Further, when contract is played as a control tool, it can motivate information and knowledge sharing (Reuer & Ariño, 2007). For instance, in a contractual relationship, firms are likely to provide their partners with timely information related to changes or innovativeness, such as improved manufacturing plans or new technology implementation. Accordingly, their partners become more responsive in their own timely updating, and in making adjustments to these changes (Tai & Wang, 2007). This allows firms to employ innovative practices smoothly and efficiently, and to meet the target of their innovation strategy. Also from a TCT perspective, when an innovation – in particular, technology implementation – involves the interdependence of different stakeholders, contract plays a vital role in reducing anticipated coordination costs and needs.

As innovation often requires a certain clarification on, e.g., technical procedures for improving products/processes and principles in order to reach desired outcomes (Jansen et al., 2005), the use of contract provides stakeholders with term specificity that enables the innovative practices to be performed appropriately and efficiently. The findings of Bouncken (2011) are empirical evidence for this. According to Bouncken (2011), when upstream directives are part of contracts that define new product concepts with objectives and guidelines (e.g., functionalities, designs, technical issues, consumer expectations of innovation components), they play a critical role in the implementation of innovation. The upstream directives can help suppliers to easily develop and supply innovative inputs in accordance with manufacturers‘ requirements, while the manufacturers can effectively manage the suppliers‘ processes and the quality of supplied components, contributing to better product and process innovation. As evident from prior research, the use of contract in promoting innovation has been confirmed by Wang et al. (2011) and Sumo et al. (2016).

Thus, it is hypothesised that:

Hypothesis 1: Contract is positively associated with SCI

3.3.1.2 Trust and SCI

Under TCT, the existence of trust helps to reduce opportunistic behaviours of the exchange partners, and facilitates lower transaction costs involved in inter-firm relationships, such as negotiating and monitoring costs (Choi et al., 2001; Laaksonen et al., 2009), thereby enabling firms to invest more resources into utilising innovative activities (Zaheer et al., 1998). In a trust-based relationship, the partners are willing to share reliable information and tacit knowledge (Paulraj et al., 2008), and engage in joint innovative activities (e.g., co-developing new products or assisting each other to improve operational processes (Poppo & Zenger, 2002), which in turn promotes innovativeness within the supply chain. An absence of trust may prevent the partners from engaging in such co-innovative activities, consequently restricting their innovation capabilities. In contrast, the existence of trust among the supply chain partners can limit resistance to innovation and smoothly promote a common strategy, thereby driving the success of innovation.

As a focal firm cannot innovate in isolation, particularly when developing a new product, implementing a new operational process or adopting new technology, the firm may have to involve other partners in its innovative strategies, such as by sharing know-how, providing guidance on developing innovative practices, and complementing their resources or capabilities. This can be accomplished only when the firm trusts and has confidence in its partners (Seuring & Müller, 2008). Trust is recognised as critical for the success of technological innovations (Ghosh & Fedorowicz, 2008; Michalski et al., 2014), such as the implementation of supply chain technologies (i.e. advanced manufacturing technologies, Forecasting and Replenishment system, Vendor Management Inventory system, Enterprise Resource Planning), because trust-based relationships can promote real-time and reliable data, integrated platforms and function-specific applications throughout the supply chain.

The influence of trust on SCI has been also expounded in other previous studies. For example, Panayides and Lun (2009) explored the notion that trust between manufacturers and suppliers promotes SCI; Song et al. (2010) proved that trust has a positive impact on firms‘ innovativeness through joint problem-solving between buyers and sellers; Wang et al. (2011) confirmed that trust positively affects firms‘ innovative performance.

Therefore, this study puts forward the following hypotheses:

Hypothesis 2: Trust is positively associated with SCI

3.3.2 SCC mediates the impact of contract and trust on SCI

3.3.2.1 SCC and SCI

From the TCT perspective, SCC allows firms to minimise opportunism and transaction costs (e.g., monitoring and purchasing costs) that occur in market transactions, through frequent communication, improved coordination, resource sharing, and risk and reward sharing between exchange partners (Cannon & Homburg, 2001; Silvestre, 2015). In such collaborative relationships, firms are more likely to share and transfer knowledge about their innovation capabilities, such as new products or technologies, to jointly improve business processes and/or to co-develop new products (Wathne et al., 1996), all of which significantly promote innovation in the supply chain. In addition, during information sharing, joint problem-solving and joint decision-making among partners, which SCC emphasises, novel ideas or different perspectives on a problem can be discussed, targeting innovativeness (Lee et al., 2014).

TCT also predicts that firms are motivated to make relation-specific investments with their partners, with whom they collaborate and share a similar vision to achieve mutual goals (Gligor & Holcomb, 2012; Henke & Zhang, 2010). This enables them to not only concentrate and coordinate their resources for innovation, but also consistently exposes them to the innovative behaviours of their partners, enabling them to learn, acquire and internalise to strategise for innovation (Oke et al., 2013). Supplier and customer collaboration, typically, can help to facilitate innovations. For example, the early involvement of suppliers in product innovation projects can help firms to avoid the high cost of changing product designs later (Gemünden et al., 1996), and to gain product differentiation by obtaining expert information aout new ideas and technologies used for developing highly innovative products (Petersen et al., 2005; Song & Di Benedetto, 2008). On the other hand, customer involvement in new product development enables firms to acquire knowledge of customer demand, which can help to increase customer satisfaction as a result of higher quality and lower costs (Lin et al., 2010).

According to Bessant et al. (2012), a large part of a firm‘s innovation capability lies in its external relationship network. In addition to this, the innovation process emphasises the role of complementary resource and co-specialisation, meaning that firms need to collaborate with their strategic partners (Teece, 2007). Under DCT, the complementary resource endowments that usually emanate from collaboration with supply chain partners allow firms to expand and modify their resources (e.g., knowledge base and technological capabilities) in quick response to environmental uncertainties. This is necessary for innovation success, as firms are often required to modify their business models in accordance with new processes or new technology adoptions. In particular, since technology often demands the concurrent use of various sets of knowledge and skills, technological innovation may require complementary skills and resources from different stakeholders (Ahuja, 2000). Thus, in response to fast changing environments and technologies, firms almost always attempt to pursue collaborative relationships in order to quickly disseminate new technologies, penetrate new markets, acquire knowledge from industry leaders and widen sourcing capabilities (Ring & Van de Ven, 1992). Furthermore, when combining skills and resources with their partners, firms may need to expand their existing capabilities and resources, driving them to initiate new ideas, processes or products (Ahuja, 2000). All of these significantly enhance innovation capabilities and increase the innovation implementation rate of firms.

Several studies have proved that the greater the collaboration among supply chain partners, the more successful the innovation. Typically, Simatupang and Sridharan (2005) concluded that supply chain members who engage in more collaborative activities are more able to achieve innovation practices and improve their operational performance. Soosay et al. (2008) identified some of the continuous innovation outcomes derived from collaboration (e.g., maintaining standardised operations, joint planning, sharing knowledge, sharing processes, joint investing, and synchronising and interfacing with customers and suppliers). Yunus (2018) found that customer, supplier and internal collaboration positively influence both radical and incremental innovation.

3.3.2.2 The impact of contract and trust on SCC

Under TCT, contract and trust play an important role in governing opportunistic behaviours and reducing transaction costs in supply chain relationships. Contract, which provides a framework for partners' behaviours, patterns of outcome division and sanctions for violating agreements (Wuyts & Geyskens, 2005), can manage conflict and reduce uncertainties in exchange relationships, thereby encouraging collaboration between supply chain partners (Poppo & Zenger, 2002). In addition, contract normally defines formal procedures and rules to maintain a relationship that facilitates effective information flow and reduced transaction costs in the exchange between partners (Choi et al., 2001). This increases incentives for collaboration between supply chain partners.

Similarly, from the TCT perspective, the presence of trust helps to reduce opportunism and transaction costs in supply chain relationships (Ireland & Webb, 2007). In such trust-based relationships, firms are more likely to rely on and collaborate with their partners (Wang, 2011), enabling them to be more open in sharing information and resources with them (Ghosh & Fedorowicz, 2008). Furthermore, trust ensures that supply chain members are involved in joint/supporting activities, such as joint problem-solving or decision-making to achieve mutual benefits (Fawcett et al., 2012; McEvily & Marcus, 2005). The existence of trust also stimulates cooperation, coordination and long-term relationships within the supply chain (Krause et al., 2007; Yeung et al., 2009), which are key components of SCC (Simatupang & Sridharan, 2007). Hence, building trust is imperative to long-term collaborative relationships in the supply chain.

Empirically, Cachon (2003) also found that coordination of supply chain activities can be enforced through the use of contracts. Chong et al. (2009) proved that trust among supply chain partners positively influences supply chain collaboration. Sridharan and Simatupang (2013) also confirmed the critical role of trust in supply collaboration, which results in value creation and appropriation.

3.3.2.3 The mediating role of SCC

Although contract and trust have direct impacts on SCI, the expected benefits are sometimes achieved through several factors such as information sharing, joint investments and complementary resources, which are critical attributes of SCC. It can be said that, without collaboration, the latent potential of contract and trust to enhance

SCI is hard to realise. In short, the use of contract and trust provide an incentive for SCC, which in turn promotes SCI, as discussed above. The higher the level of collaboration resulting from the use of contracts and trust, the greater the probability of SCI being engendered through, e.g., complementary resource endowment, relation-specific investment, information sharing, joint knowledge creation and joint problem-solving. Thus, it is expected that SCC mediates the influences of contract and trust on SCI.

Based on the above arguments, the study proposes:

Hypothesis 3a: Contract is positively associated with SCC

Hypothesis 3b: Trust is positively associated with SCC

Hypothesis 3c: SCC is positively associated with SCI

Hypothesis 3d: SCC mediates the impact of contract on SCI

Hypothesis 3e: SCC mediates the impact of trust on SCI

3.3.3 SCL and SCI

From the DCT perspective, organisational learning can create critical knowledge for innovation that enhances firms' adaptability to a changing environment (O'Reilly & Tushman, 2008). The knowledge-based view of DCT also shows that knowledge acquisition, combination and sharing are imperative for innovations (Zahra & George, 2002). This is because innovative ideas almost always arise from the knowledge gained from external partners (Li et al., 2018). Thus, firms must interact with their supply chain partners to create, imitate and internalise knowledge in order to attain more valuable knowledge resources (Choi & Lee, 1997). While learning is imperative for innovation capability-building (Madhavan & Grover, 1998), learning that occurs across a supply chain is more critical for innovations, as any attempt by a focal firm to engage its supply chain members in learning activities is more likely to enhance innovation capabilities (Calantone et al., 2002).

According to DCT, SCL allows firms to alleviate their restricted knowledge resource and exploit complementarities with their partners (Baffour Awuah & Amal, 2011; Hsueh et al., 2010), consequently enhancing their innovation capabilities. Specifically, learning from supply chain partners, firms are able to explore and obtain the latest knowledge about, e.g., probing markets, customers‘ needs, technological opportunities, competitors, and best practices in the industry (Feiler & Teece, 2014), all of which increase their knowledge base and facilitate innovations (Malhotra et al., 2005). Such knowledge-based innovations enable firms to quickly respond to possible environmental uncertainties, such as changing customer needs. Indeed, awareness of customer needs, competitors‘ products and market strategies, and new technologies in the industry, are crucial for new product development and new technology adoption by firms. In addition, when engaging in SCL, firms are able to gain insights into innovative processes from their suppliers, then to reconfigure them to enhance their own innovative capability (Knudsen, 2007).

Learning can also enable firms to gain access and exposure to various sources and perspectives of knowledge, enlightening them on novel ideas and approaches that lead to innovations (Subramaniam & Youndt, 2005). Further, learning promotes innovations through enhancing the willingness of supply chain partners to explore new ideas, associations and business opportunities, which contributes to their enhanced innovation capabilities (Song et al., 2010). Previously, Flint et al. (2008) supported the role of SCL in innovation management, which in turns affects innovation performance. Sun (2013) confirmed the positive influences of knowledge delivery and reception among supply chain partners on innovation. Lisi et al. (2019) indicated that supplier and customer learning promote green innovation in the supply chain.

Thus, it is hypothesised that:

Hypothesis 4: SCL is positively associated with SCI

3.3.4 SCI and SCP

From the DCT perspective, innovation is conceptualised as part of the dynamic capability-building process that helps to sustain firms‘ optimal performance (Mandal, 2016a; Teece, 2007). This is because innovation allows firms to modify, integrate and reconfigure their organisational structure and resources in order to quickly respond to environmental uncertainties (Teece & Pisano, 1994). Once innovative opportunities are identified and evaluated (sensing), firms then translate these opportunities into possible product, process and/or technological innovations, such as developing new products, adopting alternative/modified operational processes and implementing new technologies (seizing) (Lieberherr & Truffer, 2015; Teece, 2007). Under DCT, these dynamic capabilities increase the adaptability of firms to changing environments, and enable them to maintain a satisfactory level of performance (Teece et al., 1997).

To explain, while process innovation can help to reduce production costs and increase the efficiency of operational routines, product innovation can offer differentiated products to satisfy customer needs, thus securing a firm‘s competitive position in the market and consequently sustaining its performance (Flint et al., 2008; Lee et al., 2011). For example, innovative firms may differentiate their products by embodying a green concept in their products/processes to meet customers‘ increasing needs for and concerns about environmental-friendly products. By so doing, they can develop new market for their green products, increase sales and improve their corporate image (Haji Vahabzadeh et al., 2015). It is also said that firms with stronger technological competences can achieve higher outcomes than those with lower competences (García et al., 2012). The implementation of information technologies (e.g., RFID, electronic data interchange, web-based systems) enables effective communication through reliable information sharing, and reduce transaction and communication costs (Prajogo & Olhager, 2012), while at the same time facilitating better operational processes, a high delivery speed and a quick response to customers‘ dynamic requirements, as well as wasting elimination (Schneller & Smeltzer, 2006). Together, these significantly improve firms‘ performance.

In the context of the supply chain, in order to meet the requirements and gain the full benefits of innovations, firms need to integrate other partners in the supply chain, such as customers and suppliers, into their innovation strategies and practices (Acar & Atadeniz, 2015; Storer et al., 2014). Such co-innovations are then expected to benefit all stakeholders, contributing to the entire supply chain's improved performance (Arlbjørn et al., 2011). In this regard, as empirically tested by Panayides and Lun (2009), innovativeness can lead to improved supply chain performance, based on aspects such as quality, cost, time to market, lead times, delivery reliability, level of inventory and conformance to specification within the supply chain. Yoon et al. (2016) also proved that SC innovation positively affects SC efficiency by increasing speed, developing an efficient information network and eliminating waste.

These arguments lead to the following hypothesis:

Hypothesis 5: SCI is positively associated with SCP

3.3.5 Moderating roles of environmental uncertainties

In a context of highly uncertain demand, the future directions of the market and the future actions of external competitors are difficult to predict and understand (Krishnan et al., 2006). It is also difficult for firms to be predict their potential customers' needs and preferences (Jaworski & Kohli, 1993). This may affect the process and outcomes of their innovation strategies, particularly new product development. For example, variations in customers demand may further challenge firms, requiring them to ensure their new/improved product launch fits with customers' preferences. According to Simonin (2004), an unpredictable environment can result in a lack of logical links between actions and outcomes, or between inputs and outputs that are associated with process or technological know-how (Simonin, 2004). In addition, when seeking to be innovative in a highly uncertain market regarding demand, firms need to continuously monitor customer demand and update their innovation plans by, for instance, modifying their products and processes to meet unstable customer preferences (Jaworski & Kohli, 1993). This makes innovation plans more complicated and may negatively affect innovation performance.

A turbulent environment in which technology is changing can quickly render obsolete existing technologies that firms adopt. As a result, firms must be able to constantly cope with the rapid changes in technology (Koufteros et al., 2005), and to share information in a timely and frequent manner with their customers and suppliers (Fynes et al., 2004). This also means that firms will face problems in re-defining a product's technical feasibility or specified manufacturing processes, due to the changes in the technology used, along with additional associated costs and times (Lynn & Akgün, 1998). These tasks that are undertaken simultaneously with limited resources and capital can threaten the effectiveness of innovation activities or reduce their impact on performance (Gölgeci & Ponomarov, 2015). Furthermore, technological uncertainties may increase the complexity of cooperation and coordination (within and between firms) in innovation processes, which, in turn, diminishes the effectiveness of the innovation

(Song & Montoya-Weiss, 2001).

On top of these hurdles, SCI is a highly knowledge-intensive activity involving collaborative efforts among supply chain members. At the same time, grounded in TCT, environmental uncertainties can increase the risk of opportunistic behaviours by partners, which limit the value of cooperation and co-investment in innovativeness (Srinivasan et al., 2011). In this situation, information and tacit knowledge held by each partner might not be shared or transferred meaningfully in an uncertain environment (Wang & Fang, 2012), leading to uncertain outcomes from collaborative innovation across the chain. The TCT perspective also indicates that it is difficult to evaluate the performance of partners in a relationship under changing environments (Williamson, 2008).

In short, innovation undertaken to foster SCP can become less effective when environmental uncertainty is high. Thus, this study argues that:

Hypothesis 6: Environment uncertainties negatively moderate the impact of SCI on SCP.

3.4 Summary – towards the conceptual model

Grounded in TCT and DCT, this study proposed six research hypotheses underpinning the relationships of the model's constructs. H1 and H2 reflect the direct impacts of Contract and Trust on SCI, respectively. H3a, H3b and H3c together reveal the mediating role of SCC in the effects of Contract and Trust on SCI. H4 supports the positive relationship between SCL and SCI. Lastly, H5 indicates the impact of SCI on SCP, which is mediated by ENU (H6). Figure 3.3 adds these hypotheses to the research model.

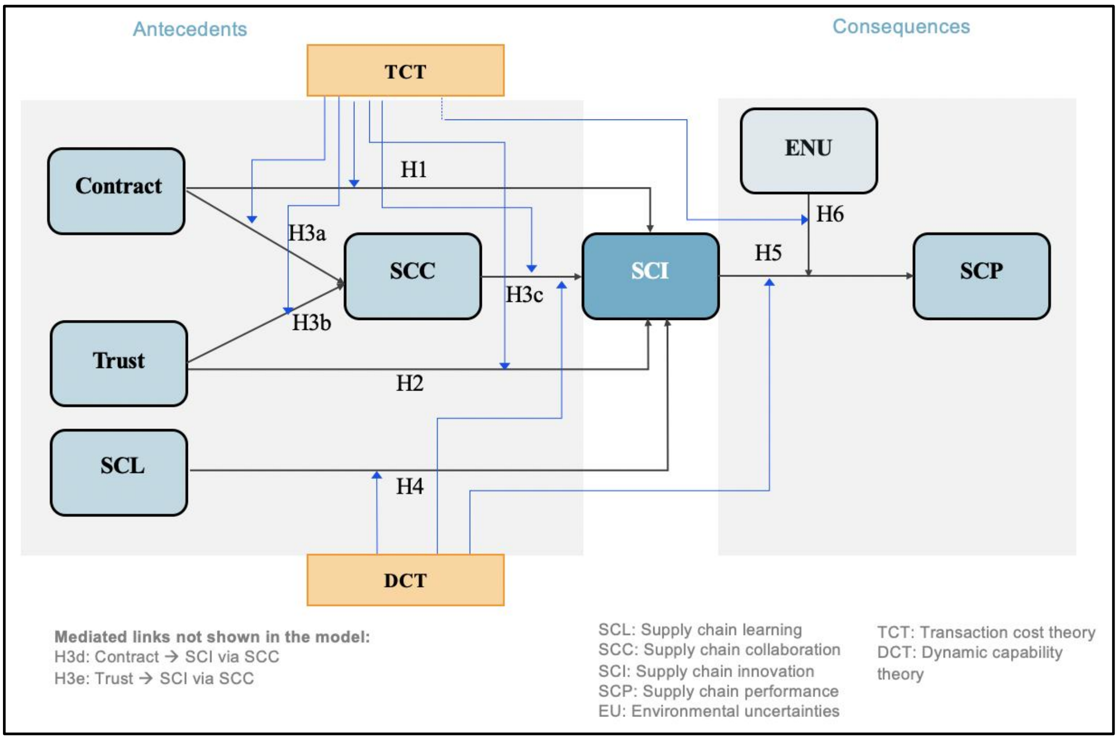

Figure 3.3: The research conceptual model

Chapter 4: RESEARCH METHODOLOGY

4.1 Introduction

Chapter 4 aims to present a comprehensive methodology of this study. Section 4.2 first provides an overview of different research paradigms, then discusses the paradigm that best suits this study. Section 4.3 focuses on the research methods and research design of the study. The section starts with a brief review of mixed methods research with different designs, followed by a rationale for the exploratory design applied to this study. Section 4.4 presents a justification of the selection of the research context in this study. The next sections describe the two phases of the mixed methods: qualitative phase (Section 4.5) and quantitative phase (Section 4.6). These sections provide details of the method used, data collection process and analysis in each phase. Lastly, the chapter ends with issues related to the research ethics addressed in this study. Figure 4.1 illustrates the structure of this chapter.

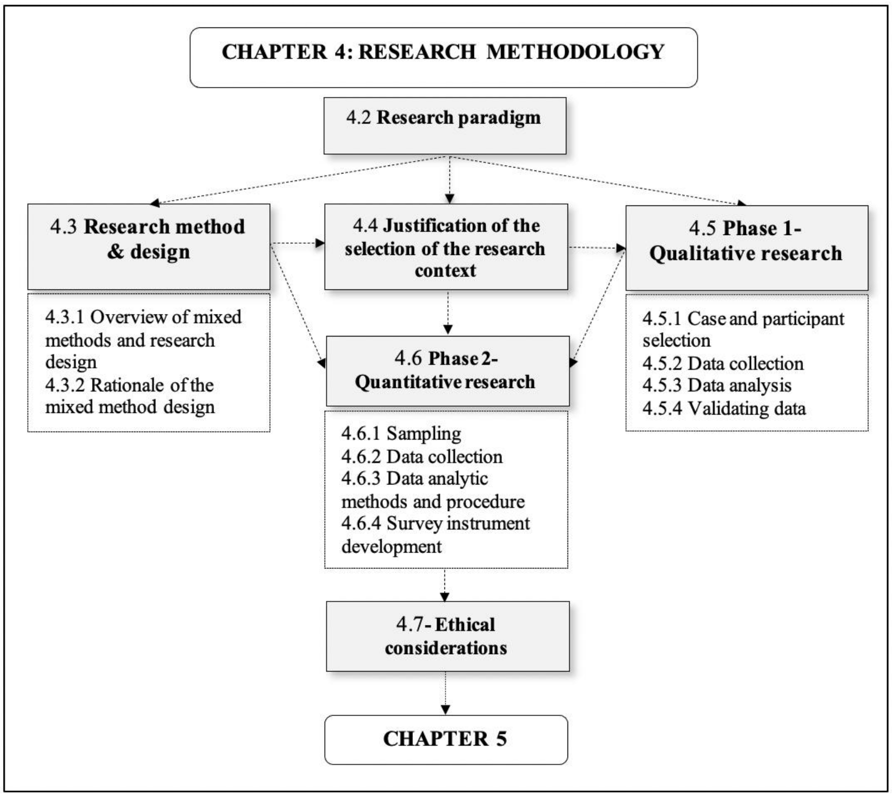

Figure 4.1: The outline of chapter 4

4.2 Research paradigm

A research paradigm is a ―world view" that guides our beliefs, thinking and assumptions about ourselves and society, and which frames how problems are resolved (Schwandt, 2001). It is central to designing and conducting research, as it influences the way in which a research study is designed and conducted. All studies first need to recognise philosophical assumptions about the world and knowledge informing inquires (Cresswell & Clark, 2007). Creswell (2003) categorised four different types of paradigm used in social research and described the main characteristics of each paradigm. First, post-positivism is often associated with a quantitative approach in which claims for knowledge are made based on cause and effect, empirical observations and measurement of variables, and theory verification. In this form of enquiry, the researcher starts from a theory, moving on to hypotheses and data to support or contradict the theory. Second, constructivism is typically linked with a qualitative approach. This approach uses the participants' view and understanding of phenomena to build broader patterns and ultimately build a theory. Third, the advocacy and participatory paradigm is usually affected by political concerns, and is more often related to a qualitative than a quantitative approach. The participants in advocacy and participatory research serve as active members who formulate research questions, analyse data and implement the findings in practice. Last, pragmatism is typically linked with a mixed-methods approach, which combines inductive and deductive thinking and utilises multiple methods of data collection, as well as a combination of quantitative and qualitative data (Creswell, 2003). These four paradigms have common elements but take different stances on these elements, including the belief on the nature of reality (ontology), the relationship between the researcher and what is to be researched (epistemology), and the means of investigating a phenomenon and producing knowledge (methodology) (Burrel & Morgan, 1979; Cresswell & Clark, 2007). The ontology, epistemology and methodology of the four paradigms are summarised in Table 4.1.

Table 4.1: Common elements of paradigms and implications for practice

Paradigm elements	Post-positivism	Constructivism	Advocacy and participatory	Pragmatism
Ontology	Singular reality (i.e., rejecting or failing to reject hypotheses	Multiple realities (i.e., providing quotes to illustrate different perspective)	Political reality (i.e., results are negotiated with participants)	Singular or multiple realities (i.e., testing hypotheses and provide multiples perspective)
Epistemology	Distance and impartiality (i.e., objectively collecting data on instruments)	Closeness (i.e., interviewing participants at their sites to collect data)	Collaboration (i.e., participants are involved as collaborators with researchers)	Practicality (collecting data through ―what works" to address research questions)
Methodology	Deductive (i.e., testing a priori theory)	Inductive (i.e., starting from participants' views to build themes and generate theories)	Participatory (i.e., participants are engaged in all stages of the study and in the cyclical reviews of findings)	Combining (i.e., collecting both qualitative and quantitative data)

Source: *Creswell and Clark (2007)*

This study was drawn from the pragmatism paradigm, which is widely advocated as the most suitable philosophical basis for mixed methods research (Cresswell & Clark, 2007). This is due to the need to consider both quantitative and qualitative elements for a better understanding of the emerging research problem: SCI, conducted in a new research context, namely, the Vietnamese agricultural supply chain. The mixed methods of the quantitative and qualitative approach complement each other and can provide a deep and broad picture of the research problems (Johnson & Turner, 2003). This study utilised a combination of deductive and inductive enquiries, using different sources of data such as in-depth interviews, direct observations and structured questionnaires to address the research questions. In relation to ontology, the researcher considered both singular and multiple realities. Single reality can be tangible and constant across setting and time, while multiple realities are constantly changing depending on political, social, cultural and power-based factors (Neuman, 1997). It is believed that there is a common reality among individuals but that there are also multiple realities that different individual can interpret in different ways (Onwuegbuzie & Leech, 2005).

4.3 Research method and design

4.3.1 Overview of mixed methods research and research design

Mixed methods research is defined as "a procedure for collecting, analysing and mixing or integrating both quantitative and qualitative data at some stages of the research process within a single study" (Creswell, 2003). It can also be called ―methodological triangulation", which refers to the convergence of quantitative and qualitative data (Morse, 1991). Quantitative data consists of closed-ended information (i.e., what is found on performance instruments or checklists). The analysis of quantitative data involves statistical analysis based on the scores collected from instruments, checklists or even public documents to test hypotheses and answer research questions. Qualitative data includes open-ended information, which can be gathered through, e.g., interviews with participants or observations, or by gathering documents available from a private or public source. The analysis of qualitative data follows the aggregation of the words, text or images into categories, and the presentation of the diversity of ideas collected during data collection. The integration of quantitative and qualitative data provides a better understanding of the research problems than if either kind of data was used alone. The mixed method research is designed to drawn on the strength of each approach, such as depth in qualitative and broad in quantitative approaches, towards a more complete analysis (Cresswell & Clark, 2007).

There are four issues that need to be taken into consideration when undertaking a mixed methods approach: interaction, priority, mixing and timing (Cresswell & Clark, 2007). Interaction, which is the level of combination of the quantitative and qualitative approaches, involves two common selections: independent and interactive design. Prioritising the two approaches can entail classifying them into equal qualitative and quantitative priorities. Mixing relates to how the qualitative and quantitative approaches can be mixed, in the context of the explicit relating of the two types of data that can occur at the design level, or during the interpretation or analysis of data. Last, timing refers to the temporal relationship of the two phases within a design, which can be differentiated as a multi-phase, concurrent or sequential design (Cresswell & Clark, 2007).

Taking these four issues into consideration, Cresswell and Clark (2007) classified mixed methods research into four common designs: (1) triangulation design, (2) embedded design, (3) exploratory design, and (4) explanatory design. First, triangulation design aims to directly compare and contrast qualitative and quantitative results, or to expand or validate quantitative results with qualitative data. It is a one-phase design in which the qualitative and quantitative approaches are implemented in the same timeframe with equal weight. Second, embedded design mixes qualitative and quantitative data at the design level, with one type of data playing a supportive role in a study primarily conducted based on the other type of data (e.g., a qualitative component is embedded within an experimental design). Third, exploratory design is a two-phase design, in which the results of the qualitative approach can help to inform or develop the quantitative approach. The exploratory phase is needed when the measures are not available or there is no guiding theory or framework. It is also most useful for exploring a phenomenon in depth, or for testing an emergent problem or theory. Last, in two-phase explanatory design, qualitative data helps to explain initial quantitative results. This design begins with the collection and analysis of quantitative data, followed by the qualitative phase for further explanation of the quantitative results (Cresswell & Clark, 2007). Mixed method researchers are recommended to select a specific design that best matches their research problem, in order to produce a more manageable study.

4.3.2 Rationale of the exploratory mixed method design

In this study, a mixed methods research based on the two-phase exploratory design, with an emphasis on the quantitative phase, was employed for several reasons.

Why mixed methods?

A mixed methods research approach is important for the investigation of a just-emerging phenomenon that has never been explored in prior research (Morse, 1991). In this study, the research problem, SCI, is considered an emerging area, only explored in recent years. In particular, investigations of SCI that consist of multiple types of innovation and involves different stages in a supply chain have been scarce in the research (Gao et al., 2017). In addition, SCI research conducted within the context of the agricultural supply chain in a developing country such as Vietnam has been missing from the literature. Another reason for the selection of the mixed methods approach is that it ensures research reliability and validity, because mixed methods research enables the triangulation that enhances the reliability and validity of research data, as well as confirming and verifying the research outcomes (O'Leary, 2017).

Why exploratory design with quantitative emphasis?

Suggested by Creswell (2003), the quantitative approach is considered the best match for research that identifies factors influencing an outcome. This is consistent with the objective of this study, which aims to test hypotheses underlying the relationships between SCI and its antecedents and consequences. However, as SCI has been mostly investigated based on a particular type of innovation for an individual firm or in a binary relationship in the supply chain, there has been no comprehensive measure of a complete SCI. This implies a need for exploratory research to guide and validate a quantitative instrument based on the qualitative results. The exploratory design is also useful for identifying new variables or hypotheses (Cresswell & Clark, 2007) about the antecedents of SCI. Furthermore, exploratory research can familiarise the researcher with all aspects of the research problem in its natural context and help in formulating the problem more precisely. Given these factors, the selection of the exploratory mixed methods design, with the quantitative method emphasised, is well suited to this study.

This research design includes two phases: qualitative followed by quantitative. In phase one, the collection and analysis of qualitative data was conducted for an initial exploration of the research problem. This was followed by a predominantly quantitative method used to test the hypotheses. The qualitative findings were then integrated, during the interpretation of data analysis of quantitative data, to produce more insights on the research problems. Figure 4.2 depicts the exploratory mixed method design in this study.

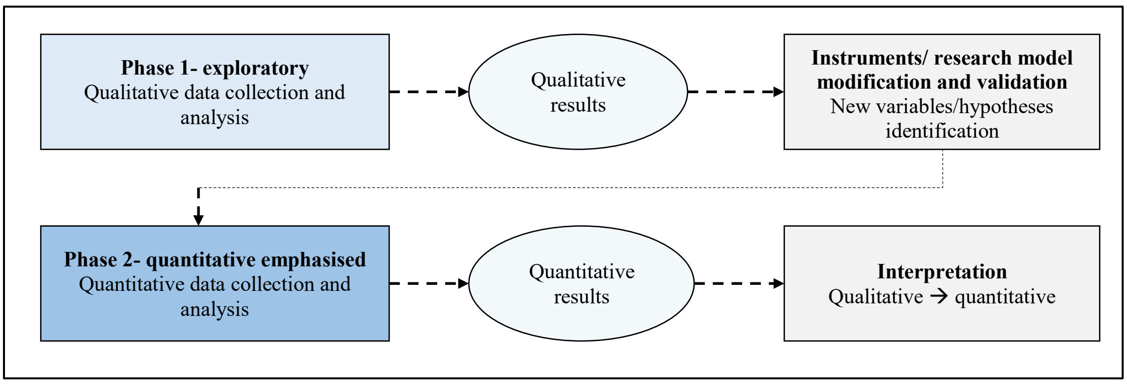

Figure 4.2: The exploratory mixed methods design (Creswell & Clark, 2007)

4.4 Research context – justification of the selection of rice and coffee SC

The research model of this study was validated and tested using empirical evidence from Vietnamese agricultural supply chains. This is based on the importance as well as current limitations of the supply chain in Vietnam, as previously discussed in Chapter 2. Among various agricultural products, the rice and coffee supply chains were selected as the main focus of this study for the following reasons:

First, rice and coffee are primary commodities of Vietnam, accounting for the largest production output compared to other products in their group (annual crop for rice and perennial crop for coffee). Table 4.2 shows the comparison of production and area harvested for the main crops in Vietnam. Rice and coffee are also leading export products, jointly making up nearly half of Vietnam's total crop exports, as shown in Figure 4.3.

Table 4.2: Production of main annual crops and perennial crops in Vietnam

Annual crop	**Production (thous. Ton)**
Paddy	42690
Sugar cane	11880
Casava	10490
Maize	4590
Sweet potato	1370
Perennial crop	
Coffee	1743
Rubber	1292
Tea	1043
Cashew nut	340
Pepper	269

. ***Source:*** *GSO (2020)*

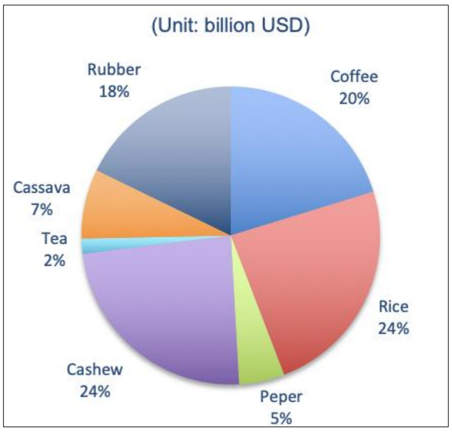

Figure 4.3: Export structure of Vietnam's major crop products (GSO, 2020)

Second, the rice and coffee supply chains can be viewed as typical models of incomplete supply chains that illustrate the inadequacies and limitations of the Vietnamese agricultural supply chain (see Chapter 2). Although Vietnam has remained among the top five global exporters of rice and coffee (FAOSTAT, 2019), these products have been almost always exported in raw/less processed forms and at discount prices (Pham et al., 2017). The supply chains have been dealing with many issues related to fragmented production, inefficient processes and poor collaboration across the chains. Both rice and coffee have also addressed sustainability issues such as the overuse of fertilisers and pesticides (Demont & Rutsaert, 2017). As shown in Figure 4.4, rice and coffee production have significant impacts on the environment, typically on natural resources such as soil, water and biodiversity (World Bank Group, 2016). All of this indicates a need for innovation in the supply chains.

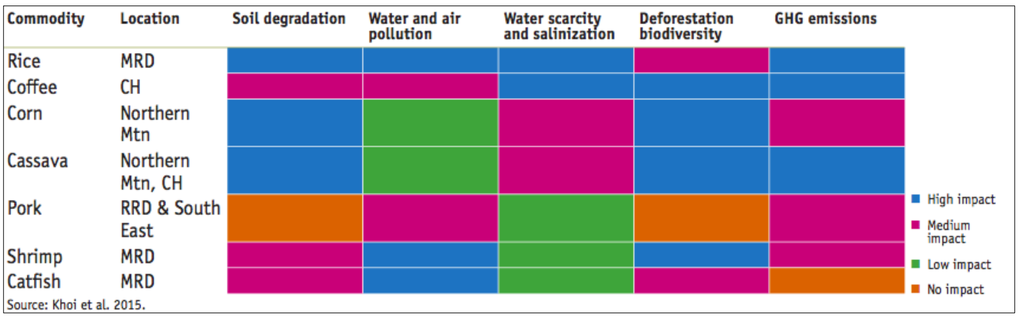

Figure 4.4: Vietnam agri-environmental hotspots (World Bank Group, 2016)

4.5 Phase 1 – Qualitative research: exploratory case studies

The findings from the systematic literature review conducted in Chapter 2 indicated that 78% of previous studies investigating antecedents of SCI were conducted following quantitative methods based on deductive enquires. In-depth and inductive enquires, which can provide a richer and deeper understanding of the investigated phenomena (Yin, 2003), are needed. Thus, prior to the quantitative investigation of the research problem, a case study-based approach was adopted to accomplish the following objectives:

(1) To find preliminary validation and support for the relationships that are portrayed in the conceptual model
(2) To enrich the model where possible
(3) To contextualise and preliminarily confirm the measures/instruments so that a

quantitative test of the conceptual model can be adequately

(4) To facilitate an in-depth understanding of the research model in the real world. This enables deeper interpretation of the quantitative results in the second phase of the study.

This initial phase employed a case study-based approach, which uses in-depth and detailed data collected from multiple sources to explore a case in its rich context (Yin, 2003). Case study research is usually used to answer ―why” and ―how” research questions, especially when a research phenomenon can be affected by the context in which it occurs (Yin, 2014). As SCI is a just-emerging area (as previously mentioned in Section 4.3.2), the case study approach is considered to best suit the investigation of such contemporary phenomena in a real life context. In addition, the distinctive need for case study research arises from the desire to understand complex social phenomena (Yin, 2014). The case study approach is commonly used in SCM research due to high level of complexity of supply chains in the real world (Ellram & Edis, 1996). In this regard, the case study approach is necessary for understanding the complex innovations in the supply chain that cover multiple stages and involve different actors in the chain. Additionally, the case study approach not only allows investigators to familiarise themselves with the research context and related industrial practices (Ellram & Edis, 1996) but also enables them to gain a better understanding and a real-life observation of the research problem (Voss et al., 2002). For instance, in this study, useful knowledge about innovative practices adopted by the supply chain members, and ―how” or ―why” the influential factors affect SCI, could be obtained from the case study findings.

In order to ensure the reliability of qualitative data, this study followed a case study protocol suggested by Merriam (1998). Multiple stages of the case study, including selecting the sample, collecting data, analysing and reporting data, and addressing the reliability and validity of data, are discussed next.

4.5.1 Case and participant selection

This study adopted the multiple case study design, which allows for comparisons and increases the possibility of finding generalisations in an analytical way (Darke et al., 1998; Yin, 2014). In this study, a small number of cases was considered for several reasons. First, fewer cases can provide more in-depth information about participants and sites (Cresswell & Clark, 2007). Second, in an exploratory design in which quantitative research is emphasised, the qualitative phase can be limited to a few participants. This helps to ensure adequate time and effort for the subsequent quantitative phase (Cresswell & Clark, 2007). In line with this, the recommended range of 2 to 8 cases was proposed by (Meredith, 1998). Thus, the decision to select four cases (2 for the rice and 2 for the coffee supply chain) for this study can be considered acceptable and reasonable.

In the qualitative phase, the study employed a purposeful sampling strategy for the case selection. Purposeful sampling allows the researcher to intentionally select sites and participants that can deliver the necessary information about the central research problem (Cresswell & Clark, 2007). In regard to the empirical focus of this study, the selected respondents are different actors operating in the rice and coffee supply chains in Vietnam.

The Central Highlands and Mekong Delta, which are the major coffee and rice producing areas of Vietnam, were targeted as research sites in this qualitative phase. The Central Highlands is the main coffee producing region, accounting for over 90 per cent of the total volume of coffee output. The Mekong Delta accounts for nearly 55 per cent of Vietnam‘s total rice production and 95 per cent of the country‘s exported rice (MARD, 2020). Several criteria were applied in the selection of the participating companies: (1) the sample was limited to medium- and large-sized companies in order to increase the possibility of innovation practices adopted by the companies and their supply chain partners; (2) the selected companies had operated in one or more core function in the supply chain, such as growing, processing, trading or a combination of these functions; (3) the selected companies had been in operation for at least five years, to ensure that adequate data for assessing their innovative performance would be available.

In addition, snowball sampling, which involves creating a sample through referrals, was also used as a complementary strategy. Interviewed companies were asked to recommend their key partners (both upstream and downstream) who might be willing to be participants in this research. The aims of this strategy were to enhance confidence in the identification and accessibility of potential participants, as well as to ensure genuine interactions between the focal firm and its upstream/downstream partners within a particular supply chain under investigation.

The selected respondents were farm owners or farmers; supply chain, operations, purchasing and R&D managers; and directors of the participating companies, all of whom have sufficient knowledge about and experience of the central research problem: supply chain and innovative practices in agriculture.

4.5.2 Data collection

The case study data was collected through face-to-face and semi-structured interviews with the selected participants (Yin, 2014). In regards to the interview protocol (see Appendix 3), the interview questions were mainly aimed at validating and refining the survey instruments, as well as identifying new variables or factors influencing SCI. Thus, it was designed to cover all aspects in the survey instruments. In addition, open-ended questions and probing questions, e.g., ―How/in what way?”, ―examples supporting arguments?”, ―Other comments or suggestions”, were also included to obtain additional and more detailed information on the research problem. the study also used additional sources of data, such as documentary analysis and direct observation, to build a more accurate and convincing case study, as well as to increase the possibility of generalising the case study findings (Casey & Houghton, 2010; Yin, 2014). Documentary analysis was based on documents or reports provided by the companies or publicly available on their websites, as well as relevant government reports. Observation was also carried out before and/or after the interviews at the companies and farms, for a better understanding of the case study context or for confirmation purposes.

The data collection process of this phase is described as follows:

i. The researcher first contacted the selected firms/farms and potential respondents and sent them an invitation letter and participant information sheet. The documents described the objectives of the study and the reasons for selecting the firms/farms as potential respondents. A consent to participate was also requested of potential respondents.
ii. Those who expressed an interest and consented to participating were contacted again to arrange a time for the interview. The list of interview questions was also sent to the respondents at this stage. The time and location of the interviews was decided based on the convenience of participants.

iii. The researcher used the following procedure for each of the interviews: the time spent on each interview was between 60 and 90 minutes; the researcher took notes while interviewing; and the interview was audio-recorded. The researcher summarised the key findings at the end of each interview.

4.5.3 Data analysis

In this phase, the study employed content analysis based on the analytic induction technique (Robinson, 1951) to analyse the qualitative data (see further details in Chapter 5, Section 5.3). Narrative analysis was also used to provide detailed narrations of the cases. The analysis of the multiple case studies was conducted at two levels: within case analysis and cross-cases analysis (Eisenhardt & Graebner, 2007; Yin, 2003). For the level of within case analysis, each case was situated in its context, and the specific content of the case was conveyed based on the case‘s description and themes (Cresswell & Maietta, 2002). Once the content analysis of each case was completed, the study performed a cross-case analysis by comparing and contrasting the cases. All the data was coded and analysed using NVivo software.

4.5.4 Validating the data

Another important step in the research is validating the data to ensure that the information obtained is as accurate as possible (Cresswell & Clark, 2007). As suggested by Cresswell and Miller (2000) and Cresswell and Clark (2007), several strategies/procedures for determining the validity of this study‘s qualitative findings were adopted as follows:

i. Participant confirmation – at the end of each interview, the researcher summarised the interview notes and asked the participant to check whether it reflected their responses. A summary of the qualitative findings was also provided to participants for their corroboration.
ii. Triangulation of data – the research data was collected and combined from multiples sources, including interview transcripts, available documents and reports, reflection notes and direct observations.
iii. Auditing – the data analysis procedure and findings were examined by the researcher‘s supervisors.

4.6 Phase 2 – Quantitative research

Quantitative research is widely used to discover phenomena that rely on variables and hypotheses, and that are generally large-scale (O'Leary, 2017). The method enables an investigation of a particular theory or conceptual framework, using empirical data (Flynn et al., 1990). Quantitative research normally uses a statistical analysis of structured data to confirm the connections between constructs (Bell et al., 2018). Among the many approaches used in quantitative research, the survey best suits the investigation of causal relationships between different factors (Hair et al., 2010). The survey approach was therefore employed to test the hypothesised relationships between SCI and its antecedents/consequences in this study.

This quantitative phase was utilised to test the conceptual model and the hypotheses based on a large sample size of surveyed data. Initially, a pilot study with a small and convenient sample was conducted for preliminary testing and to improve the wording and clarity of the questionnaire. Then, in the main study, the measurement model and structural model were tested using a number of analytical techniques/methods with the help of SPSS and AMOS software. Further details on this quantitative phase, regarding the sampling, data collection and analytic methods, are presented next.

4.6.1 Sampling

4.6.1.1 Survey sites

Figure 4.5 illustrates the map of Vietnam and the selected survey sites of this study. The survey sites encompass three main regions: the Mekong Delta, the Central Highlands and the Southeast, which are the major producers of rice and coffee. The selection was based on the importance and contribution of these three regions to the development of Vietnam‘s agriculture. Specifically, the three regions jointly account for nearly 60 per cent of Vietnam‘s gross agricultural output, and over 80 per cent of the country‘s agriculture exports (GSO, 2020). The Mekong Delta is Vietnam‘s main rice-producing region, accounting for nearly 55 per cent of its rice production and 95 per cent of its rice exports. The Central Highlands is the main producer of coffee, accounting for over 90 per cent of total volume of both coffee output and export. The Southeast is a large coffee-producing region, and the site of the largest trading market for rice and coffee, in which a number of traders and exporters operate (GSO, 2020; MARD, 2020). It is noted that only major parts/areas of these regions, those that produce or export high volumes of rice/coffee, were considered as potential survey sites. Eleven provinces were included in the fieldwork, as shown in Table 4.3.

Table 4.3: The survey sites in this study

Regions	Provinces	Characteristics	
		Main product	**Major function in SC**
The Mekong Delta	Long An An Giang Can Tho Dong Thap Kien Giang	Rice	Production Process Trading & Export
The Central Highland	Gia lai Daklak Lam Dong	Coffee	Production Process Trading & Export
The Southeast	Dong Nai Binh Duong Ho Chi Minh city	Rice and coffee	Process Trading & Export

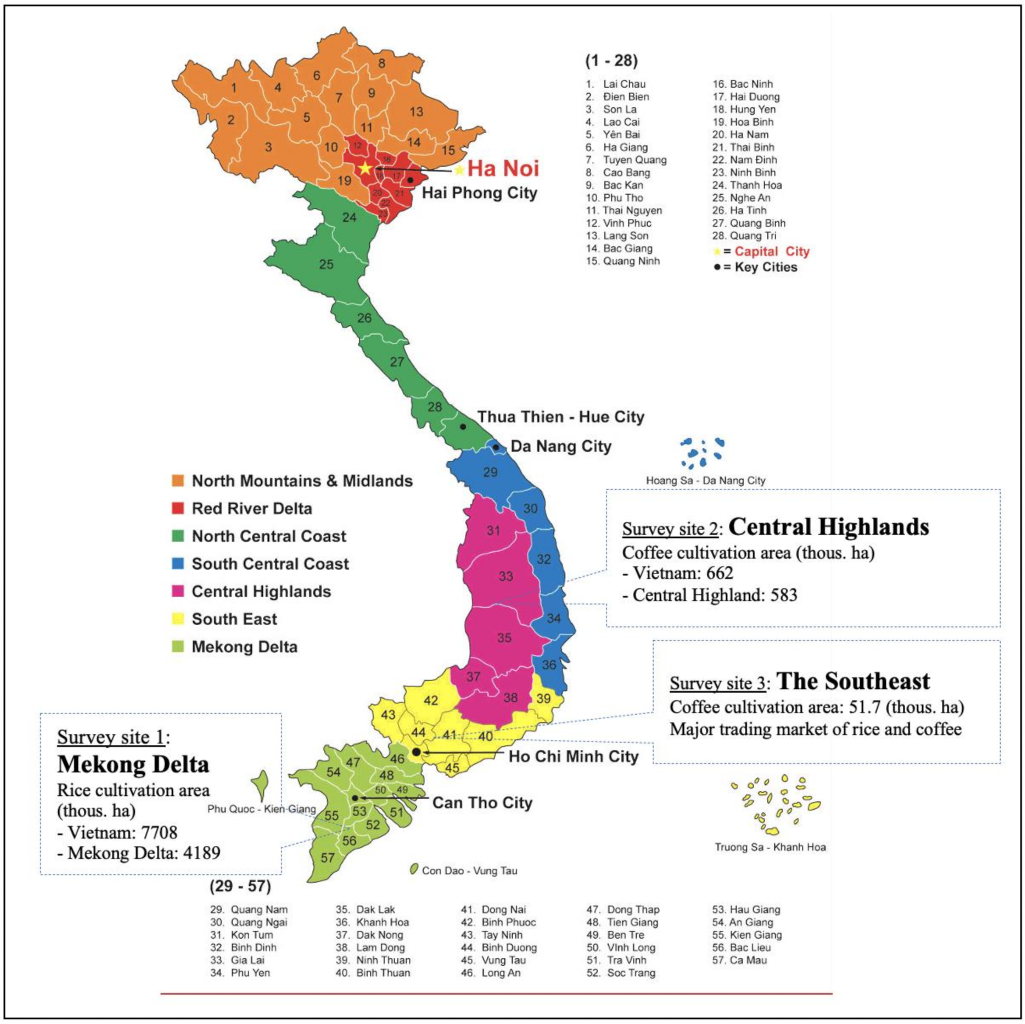

Figure 4.5: Map of Vietnam and survey sites

4.6.1.2 Sampling methods

In this quantitative phase, a random sampling strategy was adopted to select respondents. Random sampling involves a process of random selection in which each element/individual in a population has an equal chance of being selected for inclusion in a sample (O'Leary, 2017). Potential respondents in the survey sites were selected randomly from a contact list, which was generated from publicly available sources such as the websites of the Vietnamese Government and its Departments (e.g., Department of Agriculture and Rural Development, Department of Planning and Investment), or related government or provincial reports. The advantage of random sampling is that it minimises researcher bias and can be used to generalise for the entire population. However, random sampling requires that all individuals in the population are accessible and likely to agree to participating in the research. Therefore, the targeted sample size was set at 400 respondents in order to ensure the feasibility of achieving the minimum sample size required in this research (see Section 4.6.2.2).

In addition, to ensure that the sample covered an even distribution of participants across multiples stages in both the rice and coffee supply chains, stratified random sampling – in which the population is divided into its different sub-groups – was considered (O'Leary, 2017). Following this strategy, the targeted sample of 400 was proportionately divided into each supply chain (200 for rice and 200 for coffee) and was proportionate to different stages in each of the supply chains. The snowball sampling strategy was also utilised when the respondents (the focal firms) were willing to suggest/introduce their supply chain partners.

4.6.1.3 Unit of analysis and key informants

The aim of this study was to engage actors in multiple stages across the supply chains. Hence, the respondents are the actors involved in three critical stages within the rice and coffee supply chains: growers (farmers/farm owners), processors (millers/roasters) and traders/exporters/wholesalers (e.g., food or coffee companies).

For rice and coffee growers, representative participants are farm owners or key farmers in the participating farms. For processing and other companies, potential participants are supply chain managers, purchasing managers and company directors. These respondents are knowledgeable about or experienced in the issues covered in the survey, such as innovative agricultural practices, supply chain practices, and relationships with supply chain partners. The surveyed respondents were asked to respond based on their perception of their firms, and in relation to their major/best known partners, such as the largest supplier and/or group of customers in their supply chain.

4.6.2 Data collection

4.6.2.1 Data collection method and process

In this quantitative phase, data was collected using structured questionnaires based on face-to-face surveys. The questionnaire survey is considered one of the most common techniques, and an effective method for achieving a large-size sample in quantitative analysis (Blaxter, 2010; Saunders et al., 2009). The face-to-face (also known as drop and pickup) survey ensures the best and most accurate responses, along with greater feedback from respondents (Hair et al., 2000). The method was also suitable for the context of the Vietnamese agricultural supply chain. For example, the direct interview is suitable for Vietnamese farmers who have limited access to email or restricted knowledge of supply chain issues. The face-to-face survey helped to ensure that the participants, especially farmers, could clearly understand all the details on the questionnaire, and that any confusion about the content of the questionnaire could be clarified immediately (Allred & Ross-Davis, 2011). This contributed to the high reliability of collected data.

The data collection process in this phase was similar to that in the qualitative phase. The researcher first contacted the potential respondents via phone calls or emails to provide information about the research and confirm interview appointments. Individual interviews were then conducted, using structured questionnaires. During the interview, the interviewer read the survey questions to the respondents and recorded their answers. The completed questionnaires were then provided to the respondents to check whether their responses were recorded correctly. The questionnaires were collected at the end of the interview. The time spent on a face-to-face survey to complete a questionnaire was between 30 and 45 minutes.

4.6.2.2 Sample size

This study was based on Exploratory factor analysis (EFA) and Structural equation modelling (SEM), which are the main data analytic methods used to analyse the quantitative data, in order to decide on the sample size. There are various views on the sample size required for these methods. In particular, EFA requires a minimum sample size of 100 responses, or for the subjects-to-variables ratio to be no less than 5 (Bryant & Yarnold, 1995). The SEM sample size also requires at least 150 respondents (Anderson & Gerbing, 1988), or a minimum rate of five observations per variable (a ratio 5:1) (Bollen, 1989). This study has a total of 36 measurable variables (see Section 4.5.5), with the accepted sample size therefore calculated at 180. However, as the quantitative data collection involves respondents from the two separate supply chains of rice and coffee, in order to ensure the minimum sub-sample size of 150 respondents for each supply chain, as per SEM's sample size requirement, a minimum sample of 300 respondents had to be achieved. To increase the feasibility of achieving the sample size of 300, a larger sample size of 400 respondents was targeted at the beginning of the data collection.

4.6.3 Pilot testing

According to Flynn et al. (1990), pilot testing leads to the questionnaire being become easier to complete and more suited to the level of knowledge of the respondents. In this study, a pilot test, which can also be a cognitive test, was conducted to improve the clarity of the questionnaire. This helped to ensure that the target respondents could clearly understand the structure and content of the questionnaire, thereby enhancing the accuracy of their responses. The pilot testing was performed with both academics and practitioners in the field, based on a small sample size of 15 participants (5% of the minimum sample size of 300): 3 rice growers, 3 rice processors/distributors, 3 coffee growers, 3 coffee processors/distributors, and 3 scholars in the SCM field at Vietnam National University, Ho Chi Minh City. A face-to-face survey was conducted using 15 first draft questionnaires, followed by 15 minutes for participants to provide their feedback on how to improve the questionnaire. As a result, some changes to the wording of the final survey instrument were made in accordance with the pilot test results.

4.6.4 Data analytic methods and procedure

For the analysis of quantitative data, a set of multiple analytical approaches was undertaken in this study, which can be classified into three main parts: (1) assessment of biases, (2) assessment of the measurement model, (3) assessment of the structural model and the hypotheses testing. The detailed description of each approach is presented as follows:

4.6.4.1 Participant bias and common method variance assessment

This study conducted the participation bias and common method variance testing, which are the two commonly raised issues in the survey method (Lambert & Harrington, 1990; Podsakoff et al., 2003). As the data collection was undertaken over two periods of time, nearly a year apart, the possible bias between the two periods was assessed using t-test. In addition, the possibility of common method variance was assessed using Harman's single factor test for all items in this study (Podsakoff et al., 2003).

4.6.4.2 Measurement scales assessment and refinement

In pursuit of scales assessment and refinement, this study employed a two-stage approach in which EFA was followed by CFA (Anderson & Gerbing, 1988; Hair et al., 2010). First, the scales were evaluated and refined using Exploratory Factor Analysis (EFA). EFA was used to explore the structure of the scales and increase their internal consistency. This step was performed using SPSS software. In the next step, Confirmatory Factor Analysis (CFA) was conducted to confirm and validate the scales using AMOS software (Hurley et al., 1997). In general, this two-stage approach was used to test the reliability, uni-dimensionality and validity of the scales. Before presenting details of the two-stage approach, a brief review of the reliability, uni-dimensionality and validity of the scales is provided below.

❖ Brief review on the reliability, uni-dimenisonalilty and validity of scales

A scale not only constitutes the theoretical meaning of a construct, but also usually reflects measurement errors (Bagozzi & Yi, 1988). In order to reduce measurement errors, it is necessary to examine and validate the scales before testing the research model. In this study, the reliability, uni-dimenisonalilty and validity, which are the three critical dimensions of a thorough assessment of scale, were examined. Each dimension and its tests can be defined and explained as follows:

- Reliability refers to the stability and dependency of the scale (Parasuraman, 1991). It estimates the degree to which a scale is free of unstable or random error. In this study, Cronbach's coefficient alpha (Cronbach, 1951) was used to test the internal consistency reliability of the scale, which relates to the degree to which all the related items measure the same construct (Cramer, 2003). In the reliability test, the higher the Cronbach alpha, the higher degree of inter-correlation among the items comprising the scale (Hair et al., 2010). Typically, a scale is considered as having adequate reliability with coefficient value being equal or greater than 0.7 (Sellitz et al., 1976; Tavakol & Dennick, 2011). However, a permissible value of 0.6 can also be acceptable in the case of modified or new scales (Cramer, 2003).

- Uni-dimensionality of the scale relates to the degree to which items included in the scale which measure a construct represent that construct (Hattie, 1985). Under the condition of uni-dimensionality, a set of items must measure (or be associated with) only one construct (Anderson & Gerbing, 1982; M. S. Garver & J. T. Mentzer, 1999).
- Validity of a scale is defined as the extent to which it measures what it intends to measure. In this study, content validity and construct validity are applied to test the scale‘s validity. Content validity reflects the extent to which a scale can provide adequate coverage (i.e., coverage of all relevant aspects) for the construct it measures (Parasuraman, 1991). In other words, it refers to the extent to which the meaning of the construct can be interpreted by all items measuring it (M. S. Garver & J. T. Mentzer, 1999). It can be achieved when a scale is formed from a theoretical basis in the extant literature or through consulting with experts in the field (Cronbach, 1951). In this study, the scales were built based on their origin in the literature and validated through the findings of qualitative research, thereby supporting the content validity. There are two types of construct validity: convergent and discriminant validity. Convergent validity refers to the extent to which the items statistically converge together when they measure the same construct (Garver & Mentzer, 1999). Discriminant validity ensures that each item measures only one construct and is distinguished from other unrelated factors (Fornell & Larcker, 1981). Construct validity can be assessed through the correlations among items and latent constructs (Kerlinger, 1986).

❖ Stage 1- Exploratory Factor Analysis (EFA)

In this step, EFA was used to explore the structure of the scales by identifying the underlying relationships between the items and eliminating inappropriate items in the scales (Norris & Lecavalier, 2010). In the EFA technique, three key decisions have to be made for the EFA results to be valid:

(i) The method of factor extraction: The two common methods used for extracting factors in EFA include Common factor analysis and Principal component factor analysis. While Principal component factor analysis is usually used for item reduction, Common factor analysis is used to explore the latent dimensions represented in the original variables (Conway & Huffcutt, 2003). As the EFA in this study aims to identify the latent dimensions in the variables, Common factor analysis (principal axis factoring) was employed.
(ii) The number of factors extracted: Eigenvalue ≥ 1 was a criterion for determining the number of factors extracted (Kline, 2015).
(iii) The method of rotation: Promax rotation method (oblique rotation) was applied because it helps to explain the correlated factors and can compute faster than others such as Oblimin (Gaskin, 2018). The method also reflects the underlying structure of data more accurately than is provided by an orthogonal solution such as Varimax (Hair et al., 2010).

In this study, the EFA was carried out via two hierarchical steps: (i) EFA for individual scale and (ii) EFA for all scales combined. In addition, it is necessary to test the appropriateness of the data for EFA before conducting the EFA.

In EFA, a scale is uni-dimensional when only a single factor is extracted from the factor analysis (Garver & Mentzer, 1999; Hair et al., 2010). For the convergent validity, the factor loading (factor loading ≥ 0.5) and Total Variance Explained (variance extracted ≥ 0.5) were assessed (Anderson & Gerbing, 1988; Garver & Mentzer, 1999; Hair et al., 2010). Next, an analysis of reliability using Cronbach Alpha was applied to each scale to assess and refine the measurement items. Items with low item-total correlation coefficients (<0.50) were eliminated. In addition, as is defined by reliability assessment, the scale for each construct must achieve a minimum alpha of 0.70 (Hair et al., 2010).

A joint EFA with the same setting was then performed in which all items of the constructs were put together for the assessment of uni-dimensionality, and convergent and discriminant validity. In the joint EFA, items were allowed to correlate with every factor without having to correlate with only its underlying factor (Kline, 2015). In other words, the joint EFA allows investigation of the common correlation pattern of the measurement items (Fabrigar et al., 1999). In this step, different assessments were made under the following criteria: (i) Uni-dimentionality: no item highly loads on more than one factor (one item measures only one construct); (ii) Convergent validity: all items comprising a scale must highly load on one factor that represents their underlying construct (high loadings of all items of a construct); (iii) discriminant validity: no factor consists of two sets of items highly loading on it (Anderson & Gerbing, 1988; Garver & Mentzer, 1999; Hair et al., 2010).

Detailed tests for examining the reliability, uni-dimensionality and validity of the scales are presented in Table 4.4.

Table 4.4: EFA procedure and statistical tests used in this study

Procedure	Tests and tools used	Criteria	Representative References
Testing the appropriateness of data for EFA	Kaiser-Meyer-Olkin (KMO) & Bartlett's test:	- KMO ≥ 0.5 - Sig. (Bartlett's Test) < 0.05	Hair et al. (2010), Williams et al. (2010)
Testing unidimensionality	Factor extraction Factor loading	- Single factor extracted - Items significantly loads on only one construct	Garver and Mentzer (1999), Hair et al. (2010)
Testing internal consistency reliability	Cronbach's alpha test	- Item-total correlation coefficients ≥ 0.5 - Reliability coefficient value ≥ 0.7	Hair et al. (2010), Sellitz et al. (1976) Tavakol and Dennick (2011)
Testing Convergent validity	Total variance explained Factor extraction	- Factor loading ≥ 0.5 -Eigenvalue > 1 - Variance extracted ≥ 0.5	Garver and Mentzer (1999, Hair et al. (2010), Anderson and Gerbing (1988)
Testing discriminant validity	Pattern matrix Corrected-item Total Correlations	- Items significantly loads on only one construct - Correlation coefficient ≤ 0.7	Anderson and Gerbing (1988), Gaskin (2018)

- Stage 2- Confirmatory factor analysis (CFA)

In this stage, the refined scale extracted from EFA was further tested and confirmed using a series of CFA tests carried out in AMOS. Similar to EFA, CFA for individual scales was performed prior to the CFA for the whole measurement model.

In this CFA, the uni-dimensionality of the scale was examined based on the overall fit of the model (Garver & Mentzer, 1999). There are numerous fit indexes described in the literature (Kline, 2015). Among those, some fundamental measures and their thresholds used in this study are:

(i) Chi-square/df: the suggested value for a satisfactory level of the model fit is smaller than 3 (Hair et al., 2010).

(ii) Tucker-Lewis index (TLI), also known as non-normed fit index (NNFI). TLI ≥ 0.90 being indicative of a good fit (Garver & Mentzer, 1999; Hair et al., 2010).

(iii) Comparative fit indexes (CFI): for a model fit, CFI should be equal or greater than 0.90 (Hu & Bentler, 1999).

(iv) Root mean square error approximation (RMSEA): RMSEA of less than 0.06 indicates a good fit; from 0.06 to 0.08 indicates an acceptable fit (Arbuckle & Wothke, 1999; Hu & Bentler, 1999).

(v) The reliability of the scales in CFA was evaluated based on the Composite reliability (CR) at a value of ≥ 0.7 (Hair et al., 2010; Selltiz et al., 1976).

The convergent validity of individual scales can be achieved under two conditions: (1) a satisfactory level of model fit; (2) statistically significant regression coefficients (≥ 0.7) (Garver & Mentzer, 1999; Hair et al., 2010; Kline, 2015). With regard to testing of the convergent validity of the full model (all scales together), the Average Variance Extracted (AVE) was calculated with the expected value ≥ 0.5 (Hair et al., 2010).

To test for discriminant validity, in addition to AVE, additional values need to be computed: Average Shared Variance (ASV) and Maximum Shared Variance (MSV). To achieve the discriminant validity, the following three conditions have to be met: (i) the AVE needs to be higher than the MSV; (2) the AVE also needs to be higher than the ASV; and, (3) the AVE needs to have a square root higher than the correlations between inter-constructs (Hair et al., 2010). Table 4.5 summarises CFA tests in this study.

Table 4.5: CFA procedure and statistical tests used in this study

Procedure	Tests and tools used	Criteria	Representative References
Testing the model fit	Chi-square/df (IFI), Tucker-Lewis index (TLI) Comparative fit index (CFI), Root mean square error of approximation (RMSEA).	chi-square/df < 3 IFI ≥ 0.9 CFI ≥ 0.9 0.06 ≤ RMSEA ≤ 0.08	Hu and Bentler (1999), Hair et al. (2010), Garver and Mentzer (1999), Arbuckle and Wothke (1999)
Testing unidimensionality	Model fit	Accepted model fit	Garver and Mentzer (1999)
Testing reliability	Composite reliability Cronbach's alpha reliability	Reliability coefficient ≥ 0.7	Hair et al. (2010), Sellitz et al. (1976)
Testing Convergent validity	Regression coefficients Average Variance Extracted (AVE)	Regression coefficients ≥ 0.7 AVE ≥ 0.5	Hair et al. (2010), Kline (2015), Garver and Mentzer (1999)
Testing discriminant validity	Average Variance Extracted (AVE) Average Shared Variance (ASV) Maximum Shared Variance (MSV)	AVE ≥ MSV AVE ≥ ASV Square root of AVE > correlations between inter-constructs	Hair et al. (2010)

4.6.4.3 Structural model and hypothesis testing

In this study, SEM was used to test the research hypotheses. This approach allows for a simultaneous examination of causal relationships between dependent and independent constructs as a comprehensive and systematic analysis (Gefen et al., 2000), which best suits the aim of this study: to investigate the impacts of important antecedents of SCI and how SCI is linked with SCP. AMOS was used to conduct SEM.

In this study, as the empirical data was collected from two different groups of respondents from rice and coffee supply chains, prior to testing the structural model and hypotheses in SEM, a multi-group invariance analysis, which is generally used to test differences between similar models for different groups of respondents (Hair et al., 2010), was performed to examine whether the measurement and the model paths varied across the rice and coffee groups. In other words, this step was designed to test the measurement and structural equivalence of the proposed model across the two sub-samples of rice and coffee, which is a prerequisite for validating the aggregation of the two groups of the data sample. This study followed the multi-group analysis approach used by Byrne (2010), Doll et al. (2004), and Hair et al. (2010) in conducting the multi-group analysis to determine whether the two separate samples of rice and coffee could be aggregated for hypothesis testing in the pool sample. This approach was also used to test the moderating relationships in the model.

In addition, the bootstrapping approach, which provides a powerful and robust test of mediation, was employed to examine the mediating relationships in the model (Hayes, 2009; Preacher & Hayes, 2008).

4.6.5 Holistic view of the research design in this study

The mixed methods design of this study can be summarised as follows. The research conceptual model and the survey instrument were initially drawn from the critical literature review and theories. Next, the qualitative phase based on exploratory case studies was conducted, supporting the validation and refinement of the survey instrument as well as contextualising the research model. This was followed by the quantitative phase, comprising multiple stages of data analysis, which was utilised to empirically test the survey instrument and the model. The holistic design of the research is illustrated in Figure 4.6.

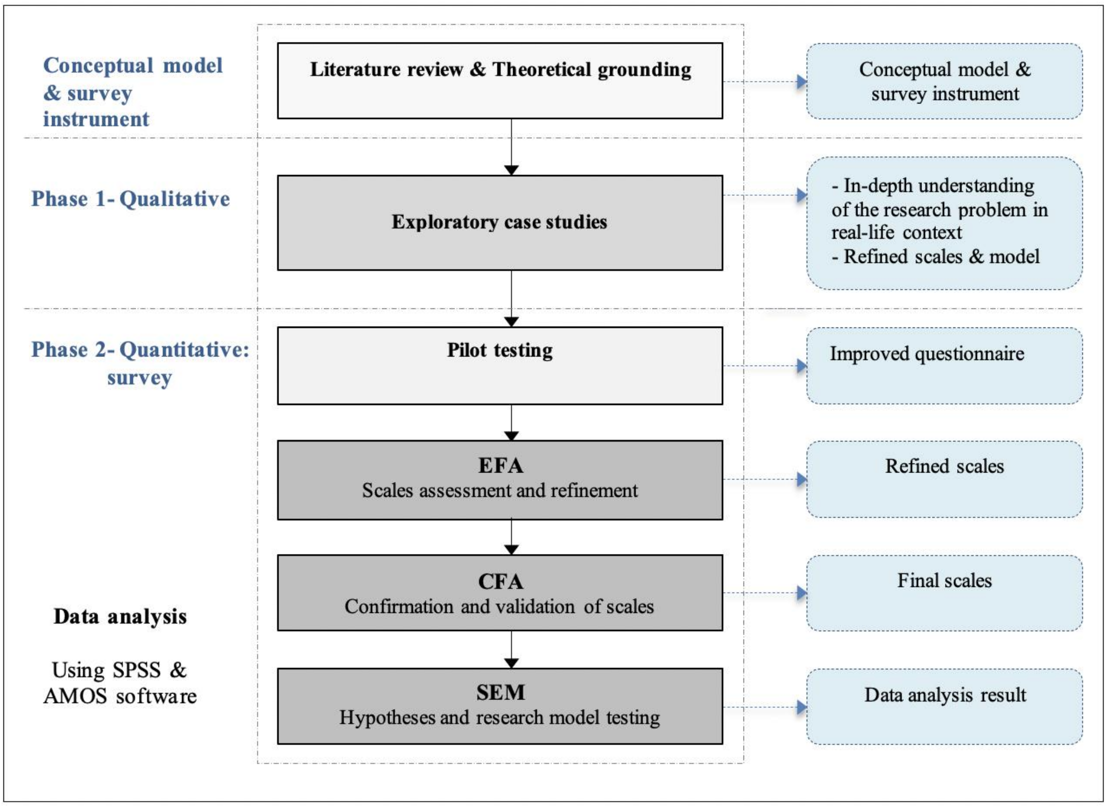

Figure 4.6: The research design and process of this study

4.6.6 Survey instrument development

As suggested by Churchill (1979) and Netemeyer et al. (2003), this study's survey instrument was drawn from previous empirical studies and slightly revised to suit the context of the Vietnamese agricultural supply chain. However, it is worth noting that the measure for SCI was designed to integrate multiple types of innovation by incorporating items reported in the literature towards the first comprehensive measure of SCI. Following previous works by, e.g., Wang (2011), G. C. Wu (2013), and Lin et al. (2009), firm age and size were considered as control variables of both SCI and SCP. The items used to measure the conceptual model's constructs and the control variables are described in Table 4.6.

Table 4.6: Summary of constructs and their measurable items

Construct	Items (content summarised)	Previous research
Trust (TRU)	o TRU1: The partner is trustworthy o TRU2: The partner always keeps their promises that it makes to our firm o TRU3: Without monitoring, the partner always tries to fulfill their obligations o TRU4: We believe to the information that the partner provides to us	Doney and Cannon (1997), Jap and Ganesan (2000)
Contract (CON)	o CON1: Contract is used to primarily govern our relationship with the partner. o CON2: Contract is used to manage the partner's behaviours o CON3: Our firm seems to communicate effectively with the partner when we use detailed contract in which the details of cooperation are fully listed	Jap and Ganesan (2000), Wang (2011)
Supply chain collaboration (SCC)	o SCC1: Sharing risks (e.g., loss on order changes) and rewards (e.g., reduced inventory costs) o SCC2: Sharing resources (e.g., machines, technical support, training) to help each other improve capabilities o SCC3: Having frequent contacts on a regular basis o SCC4: Collaborating in implementing operational activities o SCC5: Jointly developing strategic objectives	Mohr et al. (1996), Tan et al. (2002), Fawcett et al. (2011), Cao and Zhang (2011)
Supply chain learning (SCL)	o SCL1: We constantly learn better ways to operate (e.g., getting ideas about new ways of working from SC partners, looking at different approaches used by SC partners) o SCL2: We learn better ways of working with our key partners (e.g., suppliers and serve customers) o SCL3: Our key partners also learn better ways to manage their business and work with us o SCL4: We change/improve our behaviours and processes in accordance with the new knowledge that we gain from SC partners o SCL5: Learning about market, customer, or fundamental changes in the industry (e.g., technology, regulation) is frequently stimulated and shared across the SC	McEvily and Marcus (2005), Flint et al. (2008), Berghman et al. (2013)
Supply chain innovation (SCI)	o SCI1: Frequently trying out new ideas in SC o SCI2: Being creative in the methods of SC operations o SCI3: Having formal new product development processes o SCI4: Often introducing new products or improving	Hurt and Teigen (1977), Flint et al. (2008), Lee et al. (2011),

	existing products in SC ○ SCI5: Having continuous improvement in core processes in SC ○ SCI6: New process introduction in the SC has increased over the last 5 years ○ SCI7: Using technologies in SC ○ SCI8: Pursuing new technologies in SC ○ SCI9: Focusing on process and technology innovation	Panayides and Lun (2009), Michalski et al. (2014)
Supply chain performance (SCP)	○ SCP1: Delivery reliability ○ SCP2: Responsiveness ○ SCP3: Cost reduction ○ SCP4: Lead times ○ SCP5: Product quality ○ SCP6: Customer service	Beamon (1999), Narasimhan and Das (2001), Shin et al. (2000), Tan et al. (2002)
Environment Uncertainties (EUN)	○ EUN1: Consumer demand are very unstable ○ EUN2: Demand and customer' s preferences are hard to predict ○ EUN3: Technology in the industry changes fast ○ EUN4: It is difficult to implement production technology due to their high degree of technological complexity	Srinivasan et al. (2011), Land et al. (2012), Fynes et al. (2004)
Control variables	○ Firm size (number of employees) ○ Firm age (number of years operated)	Wang (2011), G. C. Wu (2013), Lin et al. (2009)

Based on these measures, the questionnaire was developed using the 7-point Likert scale, which is commonly used for structured and encrypted questionnaires (Zikmund et al., 2013). The 7-point scale was chosen in order to obtain detailed information with high accuracy in the validity and reliability of the scale (Darbyshire & McDonald, 2004). In this regard, all the items are measured based on 7-Likert scales, ranging from (1)-strongly disagree to (7)-strongly agree (7), to ensure high statistical variability among the responses. A double translation protocol (English-Vietnamese-English) was also employed to provide a comprehensive understanding of the surveyed issues. Initially, the questionnaire was designed in English, then translated into Vietnamese. The Vietnamese version was used for the data collection to ensure that the respondents could clearly understand the content of the questionnaire, which was written in their own language. The completed questionnaires were re-translated into English for the analysis. The instrument was also modified based on the qualitative findings in phase 1 and pre-tested for content appropriateness in the pilot study.

The questionnaire (see Appendix 4) is divided into seven sections. Section 1 is designed to obtain descriptive information about the company or farm, such as the nature of the business, the number of employees/farm size, and the yearly production/revenue. All of the items measuring the model's constructs –Trust, Contract, SCC, SCL, SCI, SCP and

ENU – are then presented in separate sections from Sections 2 to 6. The last section provides information about the demographics of respondents, such as age, academic qualifications, employment status, position in the company, and work experience. the questionnaire also includes a brief introduction that highlights the objectives and benefits of the research, before the main content of the survey.

4.7 Ethical considerations

As ethical issues are vital in social research studies, the researcher focused on conducting this research in a responsible and ethical manner. Ethics approval from the Ethical Committee at University of Technology Sydney was received before the data collection was undertaken. The UTS HREC approval number for this study is ETH-182961. The researcher also closely followed UTS HREC protocols for the data collection process. Some important ethical considerations can be summarised as follows:

- **Consent:** the consent of each participant was obtained before the interview. The participants were also provided with all necessary information, such as an invitation letter, a participant information sheet, and a consent form in which they stated whether they would participate in this research (see Appendix 1 and 2). Participation was voluntary. Furthermore, the participants had the right to withdraw from the research or halt the interview at any point, with no adverse consequences. This was clearly stated in the provided documents and emphasised before the interview started. The participants were also advised that they could contact the UTS HREC department with any query or complaint t about the research process, via provided contact details and the reference number of HREC approval.
- **Risks:** Neither the qualitative or quantitative phase of this research involved any of the following risks: physical (e.g., injury), psychological (e.g., distress), social (e.g., damage to social network), or economic (e.g., economic loss) harm. The only potential low risks identified included: (1) the potential inconvenience of the interviews; (2) participants' concern about privacy and/or confidentiality; (3) participants' concern that their response could affect their company's reputation. To avoid or reduce such risks, multiple strategies were developed and implemented in this study. For instance, the interviews were conducted at the participant's location, to avoid any potential physical injury during travel to and from the interview. This also helped to ensure the comfort and privacy of participants during the interviews.

The personal information collected has been de-identified and kept confidential and secure. In addition, no sensitive information about the companies or the participants was requested, and the findings will be published as de-identified forms.

- **Privacy and confidentiality assurance**: the participants were clearly assured of the confidentiality of all the information they provided. The transcripts and data obtained from the interviews/questionnaires excluded their identities, and all the research materials (paper-based surveys, interview recordings, transcripts) have been stored in a locked cabinet. The electronic data has been securely stored in a password-protected laptop and cloud. Only the researchers can access the archived data.

4.8 Summary

This methodology chapter initially justified the pragmatism paradigm and the mixed methods with exploratory design employed in this study. The study consists of two phases. First, the qualitative phase used the case study approach in which qualitative data was collected by conducting direct and semi-structured interviews. Second, the quantitative phase was based on the survey approach, with responses to questionnaires collected during face-to-face and structured interviews. The qualitative findings helped to revise and contextualise the survey instrument and conceptual model, while the quantitative analysis was utilised to test the model. All the data collection process and data analytic methods in both the qualitative and quantitative phases have been described in detail in this chapter. In addition, important ethical considerations such as consent, confidentiality and risk assessment were addressed, as evident from the ethics approval of the Ethical Committee at UTS. The next chapter will present the findings of the case study research conducted in phase 1 of this study.

Chapter 5: QUALITATIVE FINDINGS

5.1 Introduction

This study comprises two sequential phases: qualitative (case study) followed by quantitative (survey). In phase 1, four in-depth case studies were conducted. The case study results not only contextualised and confirmed, but also enriched, the theoretical model presented in Chapter 3, by suggesting an important impact of Awareness on SCI which was not identified during the literature review. In addition, the case study results delivered a reliable basis on which the conceptual model and the survey instruments were preliminarily validated for testing in the second phase of the study. This chapter presents the case study analysis and its findings. Section 5.2 provides detail on the data collection of the case studies. Section 5.3 presents the background of the cases and the participants. The coding and analysis methods are then provided in Section 5.4. Section 5.5 reports the case study findings. This chapter ends with a summary of the qualitative findings in Section 5.6. Figure 5.1 illustrates the structure of this chapter.

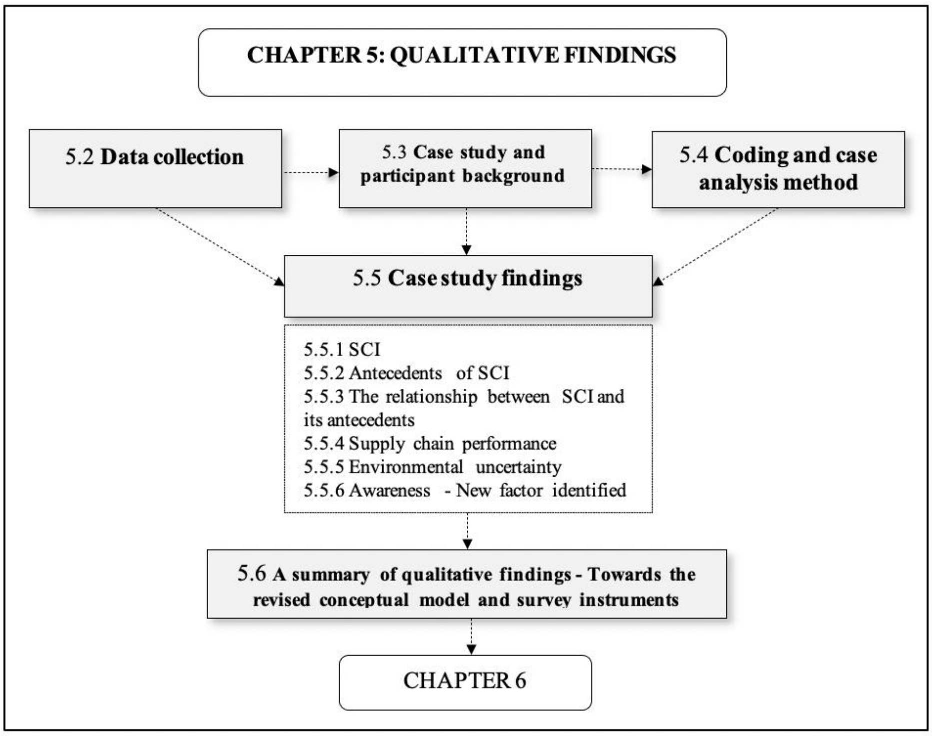

Figure 5.1: The outline of chapter 5

5.2 Case study data collection

The collection of the qualitative data was conducted from mid-November 2019 to early December 2019. As mentioned in Chapter 4, the case study data was collected through face-to-face and semi-structured interviews with the selected participants. This phase employed purposeful and snowball sampling for case study selection. The purposeful sampling strategy was first used to select the focal company in each of the supply chains (i.e., 2 rice companies located in the Mekong Delta and 2 coffee companies located in the Central Highlands). The snowball sampling was then applied, with the interviewed companies asked to introduce or suggest their key/largest partners to participate in this research (see Section 4.5.1 for further information about the sampling and case selection). The sampling method and sample selection criteria of the case study data are summarised in Table 5.1.

Table 5.1: A summary of case study sample selection criteria and process

Case study participants	Sampling method and selection criteria	Sample	
		Contact list	Interviewed
Focal company	**Sampling method:** purposeful sampling **Selection criteria:** o Medium and large sized companies o Operating in one or more than one core functions o Being in operation for at least five years	20	**4**
Focal company's partners	**Sampling method**: snowball sampling **Selection criteria:** o Being introduced or suggested by the focal company o Being the main/largest partners of the focal companies	8	**6**

In total, 10 interviews were conducted at the respondents' selected workplaces. Using a pre-designed interview protocol, each interview lasted 60 to 90 minutes and was recorded as agreed by the participants, with extensive notes also taken. The respondents were first invited to recount their innovation strategies/practices, and the perceived outcomes based on their experiences, and then to describe the factors impacting on the implementation and success of the innovations. The interviews ended with a clarification of the uncertain points and a summary of the key issues mentioned during the interviews. The respondents were advised that they would receive a survey in the near future, in the second phase of this research. A summary report of each interview was created on the day of the interview in order to construe and assimilate the information obtained from the audio recording and interview notes. As well as the interview data, the triangulation of multiple data sources was used in this study, including documentary analysis (e.g., documents/reports provided by the companies, information publicly available on their websites, government reports) and direct observation, which was carried out before and/or after the interviews at several farms/firms.

5.3 Case study context and participant background

The qualitative phase of this study was conducted by investigating 4 cases comprising 2 rice and 2 coffee supply chains. As mentioned earlier, the focal company in each supply chain, together with its major partner(s) such as a supplier or buyer, was interviewed. The two focal rice companies are hereafter referred to as _Rice company 1' and _Rice company 2', while their partners are referred to as _Rice farm 1' and _Rice farm 2' respectively. A similar method is used to refer to the coffee supply chain companies and partners. Table 5.2 summarises the main characteristics of all participants in the four cases. The demographic background of the respondents –their roles and years of experience at their firms/farms – are also provided in the table. The backgrounds of the focal company and its partner (s) in each supply chain are explained in subsequent sections.

Table 5.2: Case studies and their participants

Case	Location	Participating firm/farm	SC activities	Interviewee	Year of experience
Case 1 - Rice SC 1	An Giang	Rice company 1	Processor, trader, exporter	Supply chain manager	30 years
		Rice association 1	Grower, supplier	Director	5 years
		Rice farm 1	Grower	Rice farmer 1	15 years
Case 2 - Rice SC 2	Long An	Rice company 2	Processor, trader, exporter	General manager	20 years
		Rice farm 2	Grower	Farm's owner	14 years
Case 3 - Coffee SC 1	Gia Lai	Coffee company 1A	Processor, exporter	Regional purchasing manager	25 years
		Coffee company 1B	Processor, trader	Director	8 years
		Coffee farm 1	Grower	Coffee farmer 1	35 years
Case 4 - Coffee SC 2	Daklak	Coffee company 2	Processor, trader, exporter	R&D and investment manager	25 years
		Coffee farm 2	Grower	Coffee farmer 2	26 years

5.3.1 Case 1 – Rice supply chain 1

In this case study, three main entities in the Rice supply chain 1 were interviewed, including the focal company (Rice company 1), its collaborating cooperative (Rice cooperative 1) and one of the cooperative‘s participating farms (Rice farm 1).

Rice company 1, established in 1993, is a leading agricultural manufacturer and exporter in Vietnam. It is a large-sized company with over 3400 employees working at 25 different branches throughout the country. Rice company 1 is well-known for developing a sustainable rice value chain in the Mekong Delta that involves over 40,000 farming households, accounting for a total rice production of hundreds of thousands of hectares per year. The company‘s rice has been recognised as a nutritional rice brand produced under international sustainable standards such as SRP (Sustainable Rice Platform), and has been exported to more than 40 countries.

Rice company 1 has also been in the vanguard of developing a new model of agricultural cooperative that shows a closed cooperation between the company, the cooperatives and their participating farms. All stakeholders operate within an integrated supply chain. The cooperatives act as integrators, coordinating and managing the participating farmers. Their responsibilities also include input distribution, joint production. output aggregation, and so on. Farmers who participate in the cooperatives receive not only input materials, machinery and technology transfer, etc. but also financial support from the cooperative and the company.

As recommended by the supply chain manager of Rice company 1, the Rice cooperative and one of its participating farms, referred to as Rice farm 1, were invited to participate in this case study. Rice cooperative 1 has over 100 participating members and a total producing area of 500 hectares. Rice farm 1 has participated in the cooperative since 2015 and has a producing area of 40 hectares. The director of the Rice cooperative, together with one of the key farmers in Rice farm 1, referred to as Rice farmer 1, were interviewed to collect the case study data.

5.3.2 Case 2 – Rice supply chain 2

Case study 2 was conducted with the supply chain‘s focal company, referred to as Rice company 2, and its major supplier (Rice farm 2).

Rice company 2 is a limited liability company (Ltd) established in 1998. It specialises in rice milling, processing, trading and exporting. The company exports annually around 120,000 tons of rice to many countries, including China, Malaysia, Indonesia, Singapore, Hong Kong, the Netherlands and Belgium. Rice company 2 operates contract farming, with nearly 3000 hectares of paddy fields in Long An province. The company's rice is produced according to the Global Gap standard. It has also been recognised as a ‗Prestigious Rice Exporter', as designated by Vietnam's Ministry of Industry and Trade.

Rice farm 2, which is one of the key partners of Rice company 2, participated in this study. This farm has a total producing area of 50 hectares. The general manager of Rice company 2 and the owner of Rice farm 2 were the interview subjects in this case study.

5.3.3 Case 3 – Coffee supply chain 1

The data for case 3 was collected from a coffee supply chain in Gia Lai province, involving 3 key players in the supply chain: the focal company (Coffee company 1A), its biggest supplier (Coffee company 1B), and one of the Coffee company 1B's sourcing farms (Coffee farm 1). It is noted that Coffee company 3 acts as an intermediary between Coffee company 2 and the sourcing farm.

Coffee company 1A is a 100% foreign-owned company (FDI), established in 1997. The company has multiple branches and processing plants in different provinces in Vietnam, such as Gia Lai, Daklak, Dong Nai, Binh Duong and Ho Chi Minh city. The company exports more than 25,000 tons of Robusta coffee beans every year. According to Vietnamese Government regulations, FDI companies are not allowed to source coffee beans directly from farmers. This is why the intermediate role of Coffee company 1B is important in this supply chain.

Coffee company 1B is a family-owned enterprise established in 1995. It has been the main supplier for Coffee company 1A since 2004. Over 30% of Coffee company 1A's product is sourced from this supplier. Coffee company 1B is involved mainly in purchasing coffee beans from farmers, (preliminary) processing, and supplying to downstream partners such as the coffee roasters and exporters. The production volume of the company is about 20,000 tons a year. Coffee farm 1, which is one of Coffee company 1B's suppliers, was also involved in this study. This farm has a total producing area of 10 hectares. The interview subjects of this case study were: the purchasing manager in Gia Lai branch of Coffee company 1A, the director and owner of Coffee company 1B, and the owner of the Coffee farm.

5.3.4 Case 4 – Coffee supply chain 2

Coffee company 2 is one of the most prestigious coffee exporters in Vietnam. It is a state-owned company that was founded in 1993 and is located in Daklak province, in the Central Highlands. The company exports 110,000 to 130,000 tons of coffee annually. It has also been recognised as the strategic supplier for well-known roasters worldwide such as Nestle, D.E. Master Blenders, Jacobs and Lavazza. Coffee company 2 has been supported by more than 14,000 coffee households with a total producing area of nearly 20,000 hectares to develop a sustainable coffee value chain. Its products have been rated and awarded many international certificates by the like of the Rainforest Alliance, Fairtrade, Utz Certified and 4C.

As recommended by Coffee company 2, one of its key sourcing farms, referred to as Coffee farm 1, was involved in this research. This farm has a total production area of 20 hectares and an annual output of around 60 tons of coffee beans.

5.4 Coding and case analysis method

All recorded interviews were initially transcribed and translated from Vietnamese to English by the researcher. The transcripts, field notes and related documents were then added into the NVivo software for coding and further analysis. The qualitative data was coded by following the typical procedures of content analysis, as suggested by Yin (2017) and Lincoln (2007). The coding was initially conducted based on a set of predefined coding schemes consisting of specified categories, in accordance with the conceptual model‘s constructs. The codes include: Trust, Contract, SCC, SCL, SCI, SCP and ENU. The sub-categories were also developed using classifications identified in the literature, where appropriate, such as product, process and technology innovations, which are sub-categories of innovation; demand uncertainty and technology uncertainty, which are sub-categories of environment uncertainty; and quality, delivery, cost, etc., which are sub-categories of performance.

Each interview was coded separately to ensure the clarity of the responses. The words/phrases/sentences were grouped into the coding categories according to their perceived context meaning. The relationships between the categories were then identified. Data that did not fit any predefined code was grouped under an additional code, named ―other", in order to explore new categories. In this ―other" category, related themes based on repeated ideas or similar concepts were selected to be developed into new theoretical constructs/variables. Within each category, any inconsistencies or differences that emerged between different sources of data were reconciled by additional data sources or by verification with related respondents. Table 5.3 provides examples of data coding.

The qualitative data was analysed using analytic induction (Robinson, 1951), which is a method to extend or refine existing theories by constantly comparing them with typical cases. This study followed the typical procedures of analytic induction adopted by Yan and Gray (1994) in analysing case study data, meaning the cases were analysed one by one in an incremental manner. First, one case study was analysed, and its findings were compared with the conceptual model. The model was then confirmed or modified using the findings from the first case. This process was repeated for each of the subsequent cases. In addition, cross-case analysis was conducted to generalise the findings and finalise the conceptual model.

Table 5.3: Examples of data coding

Coding category	Example
Contract	At the beginning of every crop cycle, our company always signed contracts with farmers specifying the total areas needed, required quality and the buying price…
Trust	Trust is an indispensable factor in the coffee industry. The fact that coffee is grown and cared for by farmers, who cannot be monitored and intervened 24/7. Thus, what we can and should do is trust in them or select trusted partners to cooperate.
Collaboration	When the market price of coffee falls, both the parties shared this risk wherein each party bears one half of the difference.
Learning	Doing business in exporting coffee, it is very important for us to observe what our partners or the industry or even the world is doing (e.g., new techniques or technologies used), then we need to learn and think about how to apply them to our company.
Supply chain innovation	In recent years we have significantly improved or changed our farming practices such as the use of drip irritation that helped to save water. Our farm operates by following the 4C coffee standard.
Supply chain performance	….As a result, our coffee has significantly improved in terms of both quality and yield.
Environmental uncertainty	The market price of coffee is very unstable…
Other	The government‘s concern and intervention are important…. The biggest challenges in our innovative practices are farmers‘ poor awareness and their resistance to changes.

5.5 Case study findings

Although the case studies were analysed one by one in an incremental manner, as mentioned previously, due to space limitations this chapter reports only the overall findings as a combination of within-case and cross-case analysis results. Findings on individual constructs and their relationships depicted in the conceptual model are reported first, starting with SCI and its antecedents, consequences and moderating factors, respectively. This is followed by the final revision and confirmation of the model. Some representative interview quotes are presented to personalise and highlight the findings.

5.5.1 SCI

Both archival and interview data revealed a number of innovative practices that had already been adopted by the companies and farms in all four supply chains. Table 5.4 summarises the innovative practices adopted by the supply chain partners across the four cases. Selected illustrative comments supporting the case findings are also provided.

Table 5.4: Innovative practices adopted by case study participants

Innovative practice	Description	Adopted by	Key representative comment
Initiative in innovation	Actively seeking and applying innovative practices Being creative, trying out new ideas, learning about the successes and failures/mistakes	All SCs	―It is the fact that Vietnamese coffee is produced mainly for export markets. As the international market has become increasingly strict and selective, we have always tried to regularly update new techniques and technologies or current trends around the world to survive and compete in the industry" (Manager of Coffee company 2) ―We have always researched and tested new seed varieties to find the best one…" (Manager of Rice company 1) ―The only way to improve rice quality is to change and reform. Traditional farming is no longer suitable…" (Coffee farmer 1)
Product innovation			
Better input materials selection	Using good quality seed and healthy seedling	All SCs	―We always select high quality seedlings that help to increase yield and resistance to diseases or insects." (Coffee farmer 1)
	Better crop selection based on demand and soil condition as guided by the companies	Rice SC 1, Rice SC 2, Coffee SC 2	―We combine the market demand and soil test reports to select the most suitable crops to harvest in a every season." (Manager of Rice company 2)
Diversification of product varieties	Research on new seed varieties that promise higher quality, higher yield and pest resistance capability.	Rice SC 1	―We are operating a large-scale research institution specialising in seed varieties research. At the beginning of each crop cycle, we always provide farmers with best input materials such as seeds, fertilisers…." (Manager of Rice company 1)
Products are produced according to international standards that meet sustainability and importing requirements in different countries worldwide	Rice and coffee are produced and traded according to different international standards such as Global Gap, SRP (for rice), and 4C, Utz, Rainforest Alliance, or Fairtrade (for coffee). Focusing on green/sustainable products	All SCs	―100 % of the participating farms have produced rice according to SRP. Our ‗3 together' force, who are qualified agricultural engineers/technicians, provides day-by-day guidance and advice as well as supervises the farming processes regularly to ensure the quality of output." (Director of Rice cooperative) ―We have followed and produced 4C coffee a very long time ago." (Owner of Coffee farm 1)
Improved/new product development	Performing R&D activities to develop new products	Rice SC 1, Coffee SC 2	―We have developed a new brand name called organic coffee to meet customer's needs…" (Manager of Coffee company 2)
	Quality and safety over yield	All SCs	―Quality and safety are first and foremost. We always test the grain carefully before further process such as analysing pesticide residues…" (Manager of Rice company 2)

Process innovation			
Integrated approach: developing and sharing value across the supply chain	Elimination of intermediaries, in particular local collectors	All SCs	―We only supply our grain to the Rice company 2 for a long time." (Rice farmer 2)
	Different stakeholders such as rice/coffee companies, cooperatives and farmers operating in an integrated supply chain, rather than as isolated businesses in the past	Rice SC1, Coffee SC 2	―Our long-term strategy is to develop and share values across the coffee supply chain, especially focusing on the farmers as they start our sustainable chain." (Manager of Coffee company 2) ―We have developed a program called ‗Together with farmers to the field' in 2006. This program helped to create a quantum leap in making modern farming techniques available to the farmers nationwide." (Manager of Rice company 1)
	Seamless flow of information among the SC members	All SCs	―The Coffee company 1A always share timely demand information with our company. We then share this information with our farmers to ensure product volume and availability when demand arises…" (Director of Coffee SC 1B)
Better crop production through improving current farming processes or employing new techniques	Improving sowing, harvest and post-harvest processes to maximise grain yield and minimise losses or quality spoilage e.g., harvesting at the right time, no delay in drying after harvesting, using proper threshing machine	Rice SC1, Rice SC 2	We have performed the post-harvest processes like threshing, drying and milling in a serious way because these steps determine the quality of rice. For example, paddy is threshed on the same day of harvest then is dried soon after threshing for over 3 days to prevent grains from fermentation. We especially invest in efficient milling machines that helps produce even and stable quality of rice." (Manager of Rice company 2).
	Employing new techniques for productivity increase and resource saving e.g., multi-cropping or inter-cropping	Coffee SC 1, Coffee SC 2	―We have implemented inter-cropping between coffee and pepper to increase productivity and to save water." (Coffee farmer 2)
Embracing modern farming techniques	Implementation of modern farming techniques such as drip/controlled irrigation or water alternate wetting and drying (AWD) technique for water use, intercropping, system of rice intensification (SRI), wet processing of coffee etc.	Rice SC 1, Coffee SC 2	―In the past we used traditional irrigation methods consuming about 600 litres of water per coffee tree. This not only wastes natural resources but also requires significant human effort. We are now able to save about 40% - 50% of water by using drip irrigation." (Coffee farmer 2). ―Our participating farmers were trained to apply alternate wetting and drying (AWD) technique to save water." (Director of rice cooperative) ―Our company has introduced wet processed coffee. Compared to drying processed coffee, wet processed coffee has a higher quality and is traded at a higher price, but it requires specific equipment and has a more complicated process." (Manager of Coffee company 2)
Implementing sustainable production	Shifting from resource intensive to knowledge-based production:	All SCs	―We have used the combination of bio and organic fertilisation, known as bio-organic

aimed at optimising processes, reducing waste, gaining economic advantage, minimising environmental impacts and improving social conditions	proper planting and sowing practices, better management of soil by improving soil fertility using organic fertilisers, integrated pest management		fertiliser, to improve soil fertility and increase crop yield.” (Coffee farmer 1)
	Strictly following the guidelines of sustainable production	Rice SC 1, Coffee SC 1, Coffee SC 2	“To ensure SRP rice production, we have followed SRP scoring framework to evaluate and reward the participating farms. The framework includes 46 criteria for sustainable rice production underlining 8 main issues: field management, pre-cultivation, irritation, fertilization, pest management, harvest and post-harvest, health and safety, and labour rights. For example, under the SRP standard, farmers are required to adopt certain practices in relation to greenhouse gas emissions such as not burning rice straw, proper handling of pesticide bottles or containers…” (Manager of the Rice company 1)
Technological innovation			
Smart farming based on new/advanced technologies	The application of advanced technologies and automation for more efficient farming processes such as drone spraying and spreading, Internet of Things (IoTs) connected technologies such as satellite remote sensing, and Big data analytics for decision support and timely agriculture advice, QR code for product traceability etc.	Rice SC 1, Coffee SC 2	“In collaboration with Netherlands, we have applied satellite remote sensing technology to capture the rice situation in greater detail such as the growth of the rice plant, projected rice yield, forecast for disease, climate…to generate timely agricultural advice” (Manager of Rice company 1) “Using SAT4RICE application through smartphone, we are able to obtain full information about the rice field in each season such as harvest date, water and fertiliser situations, warning for drought or pests…” (Rice farmer 1) “Almost every year, investments in new equipment and modern machinery are invested.” (Manager of Coffee company 1B)
Systematic management through the deployment of Information System	The implementation of ERP (Enterprise Resource Planning) or CRM (Customer Relationship Management) in automated and integrated management of business activities.	Coffee SC 2	“The implementation of ERP helps us develop a unified management system with standardised processes, automatic management and control of all business activities ranging from procurement, production, warehouse, sales to accounting…” (Manager of Coffee company 2)
Efficient communication using digital applications	The use of smart phone and social media applications for online communication and learning across the supply chain	All SCs	“I usually use a smart phone to get an update on market prices and new techniques in the industry.” (Rice farmer 1) “We contact with Coffee SC 1A regularly via Facebook or Zalo to share updates on their orders and our stock availability also” (Director of Coffee company 1B)

In summary, research results indicated that all the cases demonstrate adoption of innovations across the supply chains. However, the four supply chains exhibited differences in the level of novelty and the number of innovative practices adopted. Rice supply chain 1 and Coffee supply chain 2 revealed radical innovations with many innovative practices, using significantly improved/new processes and advanced technologies aimed at the modern and sustainable development of rice and coffee. By contrast, Rice supply chain 2 and Coffee supply chain 1 preferred to implement incremental innovations such as improved processes, updated techniques and investment in new machinery. It was also observed that the degree of innovation varied according to the size, strategic objectives and financial capability of the companies/farms. For example, Rice company 1, which is a large-sized and leading company in agricultural production and export, is considered the most innovative company, having adopted a large number of radical innovative practices. Overall, the findings indicated that innovations in agricultural supply chains are adopted as an integrated change and development pattern in areas relating to product, process and technology, and can be seen in the diversification of product varieties/new product development, the application of best practices in farming and advanced technologies.

5.5.2 Antecedents of SCI

This section discusses case study findings on individual constructs included in the conceptual model with respect to the antecedents (Contract, Trust, SCC, SCL) and consequences (SCP) of SCI.

5.5.2.1 Contract

The role of Contract was explicitly specified, and a consistent pattern was observed across all the cases. It was found that Contract is an important mechanism for enabling strategic control of partners' behaviour and to secure partnerships. Rice farmer 2's comment was illustrative: *"We always sign contracts with purchasing companies at the beginning of the season. The contracts clearly specify the agreements between us in terms of the conditions for growing, the required quality and the price of paddy…"*. The manager of Rice company 2 also stated that Contract is crucial for the implementation of contract farming. It has become attractive to farmers, as the arrangements provide them with an assured market and production support, while offering the company a guaranteed supply. The use of Contract also helps to reduce potential risks for both sides. For example, the practice of farmers using inputs supplied by company A, but selling their products to company B or doing so when company A failed to buy farmers‘ coffee at the agreed prices, is very common in the industry. In this case, a contract is necessary to resolve any problems or conflicts that may arise between buyers and suppliers, as the manager of Coffee company 2 observed.

5.5.2.2 Trust

Evidence supporting trust was presented across the four cases. For example, in Coffee supply chain 1, Coffee company 1A trusts its upstream partners, saying:

> *"Trust is an indispensable factor for the coffee industry. The fact is that coffee is grown and cared for? by farmers. We cannot monitor and intervene 24/7. Thus, what we can do? Are select trusted partners to cooperate? However, I can say that our suppliers are trustworthy, and we are partners with each other for many years."* (Purchasing Manager of Coffee company 1A).

Similarly, Rice supply chain 1 exhibits a high level of trust between its members, as evident from their confidence in their sourcing farms. The Rice company 1‘s manager asserted: *"Most farmers, especially those in the Mekong Delta, are simple-hearted, honest and reliable"*. In return, Rice farmer 1 also declared his trust and dependence on the company and the cooperative. In another example, trust existed but was only marginally important to Rice supply chain 2. The General Manager of Rice company 2 explained he trusted the farmers only partially. He found it quite risky to entrust everything to farmers, as sometimes the company needed to supervise their farming processes and inspect the quality of the purchased products carefully.

5.5.2.3 SCC

The case study data revealed collaboration in the four cases, as remarked on by the companies and farmers in the four supply chains. The following quotes provide some evidence:

> *"Since joining the cooperative, we have received a lot of support from the company and the cooperative regarding input materials, machinery, training etc. In particular, the company"s „3 together" force, who are the agricultural engineers/technicians, have worked closely with us and guided us in the SRP*

farming techniques whenever we need them. We had day-by-day contact and communication via phone and a few physical visits…" (Rice farmer 1)

"When the market price of coffee falls, both the parties share this risk wherein each party bears one half of the difference." (Manager of Coffee company 1A)

"Our cooperative"s members are usually involved in our meetings relating to making decisions on harvesting schedules and planning of appropriate input materials for the next season." (Director of the Rice cooperative)

To conclude, there is abundant evidence supporting the role of collaboration, as reflected in areas of resource and risk-sharing and in joint decision-making, as well as regular communication between the supply chain partners. However, the level of collaboration varies across the four supply chains. In fact, while Rice supply chain 1 and Coffee supply chain 2 engaged in a high level of collaboration, collaboration existed only to some extent or was absent in the other two supply chains, as revealed in the following quotes:

"…Nevertheless, we cannot enforce all green practices in several sourcing farms because they are quite conservative in changing their traditional farming techniques." (Manager of Rice company 2)

"The list of our sourcing farms is updated every year. This is based on the evaluation of the farms regarding their coffee quality and, of course, their performance from last season." (Manager of Coffee company 1B)

5.5.2.4 SCL

The case study data provided evidence about learning adopted by the various actors in the four supply chains, as perceived by the interviewees. Most of the farmers interviewed explained that information about market prices, high-quality inputs and farming methods were usually shared and updated by them and the companies. They have also learned from each other's experiences and from multiple internet sources. Rice farmer 1 stated: *"In recent years, having been trained and given technical support by Rice company 1 and the Cooperative, we are able to approach and adopt modern farming techniques to grow high-quality and clean rice"*. Most of the interviewees mentioned that there were many agricultural conferences, workshops, seminars and training sessions organised annually that attracted multiple stakeholders including researchers, companies, cooperatives and farmers. The manager of Coffee company 2 also asserted:

> *"Our company has provided regular training sessions to our farmers, about 6-7 times a year to ensure proper cultivation practices that meet the standard of sustainable coffee. We also took these opportunities to listen to our farmers" opinions and expectations and make appropriate adjustments to our policy."*

In contrast to the above viewpoints, Rice farmer 2 said: *"There are many conferences and seminars organised in a year, but the practical benefits were not as much as expected. Honestly, we sometimes attended these events as encouraged by the local authorities. Information about innovative practices and technologies interest us, yet whether and how we acquire and apply it remains a long story."*

- To sum up, evidence supporting Contract, Trust, Collaboration and Learning and their component variables were presented in all the cases. While a consistent pattern of Contract was observed across the cases, the pattern of Trust, Collaboration and Learning slightly varied from one case to another. For example, in Rice supply chain 1 and Coffee supply 2, Trust was supported by all the supply chain partners, while a different experience of trust between the partners was found in the other two supply chains. This pattern is similar with Learning across the four cases. In another example, three of four supply chains engaged in stronger collaboration between the supply chain members than in the fourth, where the intermediate company (Coffee company 1B) aimed to build and maintain a collaborative relationship with its downstream buyer (Coffee company 1A) rather than its upstream partner (Coffee farm 1) in the supply chain. Table 5.5 summaries these results.

Table 5.5: Patterns of contract, trust, collaboration and learning across the cases

Construct	Rice SC 1			Rice SC 2		Coffee SC 1			Coffee SC 2	
	Rice company 1	Rice association	Rice farmer 1	Rice company 2	Rice farmer 2	Coffee company 1A	Coffee company 1B	Coffee farmer 1	Coffee company 3	Coffee farmer 2
Contract	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)
		High		High			High		High	
Trust	(+)	(+)	(+)	(-)	(+)	(+)	(-)	(+)	(+)	(+)
		High		Low			Modestly high		High	
SC collaboration	(+)	(+)	(+)	(+)	(+)	(+)	(+) (-)	(-)	(+)	(+)
		High		High			Low		High	
SC learning	(+)	(+)	(+)	(+)	(-)	(+)	(+)	(-)	(+)	(+)
		High		Low			Modestly high		High	

(+) = supported by the interviewee (-) = not supported or evidence being not available

High = All sources of data are in agreement Modestly high = At least two sources in agreement Low = one source supported and the other one not

5.5.3 The relationship between SCI and its antecedents

This section provides a summary of the findings on the relationship between SCI and its antecedents, including: Trust, Contract, SCC and SCL, as depicted in the conceptual model.

5.5.3.1 Relationships between Contract, Trust and SCI

In the conceptual model, a positive relationship between the control mechanism, which is represented by trust and contract, and SCI is depicted. All four supply chains supported this relationship. The data revealed that the partners in a contractual relationship, or with a high level of trust in each other, are more likely to co-adopt innovations. This is in line with findings by Wang (2011). The use of Contract and Trust. which minimise opportunistic behaviours and deliver lower transaction costs, provides incentives for co-value creation (Cao & Lumineau, 2015; Laaksonen et al., 2009). This is revealed by Rice farmer 1's comment below:

> *"Initially, we made a decision to participate in the rice cooperative and produce SRP rice based on our trust in the cooperative and rice company 1 as we had no idea about sustainable production at that time. We believe that they will help us to change our current situation…"*

The director of the Rice cooperative also observed that the use of detailed contracts between stakeholders enabled the innovative practices to be performed smoothly and efficiently because all the related procedures, guidelines and objectives were clearly defined in the contracts.

5.5.3.2 Relationship between SCC and SCI

The importance of SCC to SCI was also highly supported by the case study data. Collaboration is considered as the basis and driving force of innovation implementation, as well as promoting innovation capabilities. A firm's ability to collaborate with supply chain partners is key to its innovation success (Swink, 2006). In collaborative relationships, firms usually share information and resources, jointly solve problems, and make decisions that increase their innovation capabilities (Soosay et al., 2008). The comment by Coffee farmer 2 is very illustrative: *"We have gained many benefits from collaborating with the company, which has provided us with great support such as providing input materials, know-how, training and technologies to grow sustainable coffee. We are incapable of implementing these fundamental changes with limited access to the required knowledge and technologies, especially restricted financial capability."* In another example, Rice company 2 explained that innovations in the agricultural supply chain require the involvement of different stakeholders, resource and knowledge sharing, and technology transfer within the supply chain partners. These practices can be only implemented or achieved in a long-term and collaborative relationship between the partners.

5.5.3.3 Relationships between Contract, Trust and SCC

The conceptual model depicts the mediating role of Collaboration in the impact of Trust and Contract on innovation. Specifically, Trust and Contract affect Collaboration, which in turn promotes SCI. Collaboration has significant impacts on SCI, as presented earlier. The case study data also provided evidence supporting the effects of Contract and Trust on SCC, which is consistent with previous literature (e.g., Fawcett et al., 2012; Poppo & Zenger, 2002; Yeung et al., 2009). Relevant information could be found in the comment by Rice farmer 2: *"In the past, we sold our rice grain to local collectors. In recent seasons, we have moved to do contract farming with Rice company 2. We made this decision because the company is credible and trustworthy, as recognised by other farmers nearby, who joined the company a few years before me. We found confidence in a business relationship grown under contracts as we were cheated and scammed by the collectors several times."* The manager of Coffee company 1B provided more information:

"We always select reliable farmers to do business with. How? We are part of the local traders who know most of the farmers and their farms in this area well. A cheating business partner can only survive for a few seasons."

Compared to the SCC-SCI relationship, less evidence was found to support the impacts of Contract and Trust on SCI. The above quotes help to confirm the importance of Trust and Contract to the contractual relationships between the farmers and the companies, but fail to provide clear evidence specifying the collaboration activities between these partners, such as resource- or risk-sharing, or long-term cooperation.

5.5.3.4 Relationship between SCL and SCI

As perceived by the interviewees, innovation requires a great deal of relevant knowledge and skills. Thus, participants in a supply chain have to obtain critical information and knowledge from external partners, and learn from each other, to generate novel ideas and innovations. For example, in order to innovate, the case study companies initially needed to observe and be aware of new trends, techniques and technologies, not merely in the industry but also around the world. This information and knowledge are then shared with upstream partners, in particular, cooperatives and farmers, through meetings and training sessions. All the supply chain members should learn from each other in order to innovate, the manager of Rice company 1 and Coffee company 2 suggested. Rice farmer 1 also observed:

–The training sessions or seminars organised by the cooperative and the company are very useful for us to get updated on the market, new technologies and new farming techniques etc. in the rice industry so that we can have access to the necessary knowledge and skills required for the production of high quality and sustainable rice."

These cases have demonstrated the importance of Learning in SCI, which is line with the findings of prior studies (e.g., Iddris et al., 2016; Lisi et al., 2019).

- The evidence supporting relationships portrayed in the conceptual model were acknowledged in most of the interviews and presented across all the four cases. The findings confirmed the positive influences of Contract, Trust, SCC and SCL on SCI and on the adoption and success of innovation in the rice and coffee supply chains. It should be noted that the relationships between Contract/Trust and SCC were partially supported by the interviewees, but with less evidence compared to other relationships. In other words, there is a lack of strong evidence from the case studies to illustrate the mediating role of SCC in the effects of Contract and Trust on SCI. The quantitative phase of this study will further test this indirect relationship.

5.5.4 The influence of SCI on SCP

The outcomes of SCI were measured based on its influence on SCP as well as the degree to which supply chain members were satisfied with the achievement of their innovation practices. The case study data suggested that SCI has significant impacts on SCP, underlining different indicators such as delivery reliability, cost, quality and responsiveness, etc. This finding is supported in the existing literature (Panayides & Lun, 2009; Seo et al., 2014; Singhry, 2015; Zailani et al., 2015). To better understand how SCI contributes to performance, the results of each of individual case study are reported below.

5.5.4.1 Rice supply chain 1

Despite Rice company 1 having experienced some losses over the first three years of implementing the SRP rice project, it has become more profitable and acquired a higher market share in many countries since the fourth year. The company's rice brands are trusted and favoured by both domestic and international markets. Supply chain performance has also been significantly improved in terms of product quality, yield and conformance to international standards. In addition, this case study is the first integrated and most successful supply chain to achieve sustainability while increasing the sector's profitability and global market share, simultaneously reducing impacts on the environment and improving farmers' livelihoods. The comment by Rice farmer 1 was illustrative:

> *"Since joining Rice company 1's supply chain, our rice has improved significantly in terms of quality and crop yield. The production costs were also reduced as a result of the reduction of input resources such water, fertilisers, pesticides and labour costs. This also contributed to better protection of the*

environment. Additionally, as our rice is produced based on SR, it has been exported to many countries and our income has increased accordingly."

5.5.4.2 Rice supply chain 2

Overall, data obtained from the Rice supply chain 2 suggested a positive relationship between SCI and performance. First, SCI has enabled the company to better meet the needs and tastes of customers in different markets, both local and international. The company is also satisfied with the rice sourced from the collaborating farms. Furthermore, over the past five years, the company has reduced its losses, which were caused by the rejection/import refusal by international buyers due to poor quality or high content of pesticide in the grain. The export market of the company has expanded considerably, as it now relies less on Chinese markets, the general manager of the company observed.

5.5.4.3 Coffee supply chain 1

Coffee supply chain 1 has achieved higher performance as a direct result of implementing innovations. Coffee company 1A indicated that it has achieved a significant cost reduction in areas such as purchasing and delivery costs. In recent years, nearly 40% of the company‘s coffee has been exported to Japan, where strict regulations on import are imposed. This demonstrates a significant improvement in product quality and safety. The company‘s key supplier, coffee company 1B, also stated: *"Our company has been the key supplier of Coffee company 1 for a long time as the quality of our supply is very good and stable over many seasons. Also, we usually satisfy all the requirements of the company, from product variety and volume to providing reliable delivery."*

5.5.4.4 Coffee supply chain 2

The evidence from Coffee supply chain 2 suggested that SCI is significantly associated with high performance. The company has acquired a large market share to become one of the leading coffee exporters in Vietnam. The implementation of the Sustainable coffee project has enabled it to develop sustainably, resulting not only in reduced operating costs but also reduced environmental impacts, the manager of Coffee company 2 asserted. This was also highlighted by Coffee farmer 2:

"Growing 4C coffee has allowed us to increase coffee quality and productivity a lot. We have also reduced production costs through reducing waste and minimising the consumption of resources…"

- In summary, the qualitative data revealed the impact of SCI on the performance of the four supply chains with respect to different degrees of achievement in each supply chain, measured across different indicators, as shown in Table 5.6. Most of the indicators of performance were found, except for Lead time (time elapsed between the receipt of a customer order and the delivery of the products), for which no data was recorded. As the manager of Rice company 1 observed, rice farming is normally based on seasonal cultivation and harvest, which should be performed at the appropriate time. Thus, lead time reduction was not the main objective of the innovation adoption. On the other hand, the manager provided information about his product's conformance to specifications, resulting from the implementation of current innovative practices. Conformance to specifications refers to the ability of a product to meet its defined requirements (e.g., standard for sustainable rice production, or standard for international trade of rice). The importance of this indicator was also supported by most of the other interviewees. Furthermore, it captures important aspects of supply chain operations as empirically tested and validated by previous research, in particular, the work by Panayides and Lun (2009) and Shin et al. (2000). Given these, Conformance to specifications was taken to be a substitute for Lead time as a measurement of supply chain performance. A summary of the impacts of innovation on performance with respect to different levels of achievement in the four supply chains is provided in Table 5.6.

Table 5.6: SCP and the level of achievement across the cases

Performance indicator	*Degree of achievement*			
	Rice SC 1	**Rice SC 2**	**Coffee SC 1**	**Coffee SC 2**
Delivery reliability	Yes	No	Yes	Partially
Responsiveness	Yes	Partially	Not mentioned	Yes
Cost reduction	Yes	Yes	Yes	Largely achieved
Product's conformance to specification	Largely achieved	Partially	Yes	Yes
Product quality	Largely achieved	Yes	Yes	Largely achieved
Customer service	Yes	Yes	Yes	Not mentioned

5.5.5 Environmental uncertainty

Both the rice and coffee industries exhibited demand uncertainties (e.g., variations in market demand and customer preferences) and technological uncertainties (e.g., rapid changes and complexity of technologies) (Badri et al., 2000; Fynes et al., 2004), as the following quotes suggest:

> *"The coffee industry depends greatly on the world coffee market price. The market demand is uncertain and changes as its price changes."* (The manager of Coffee company 1)

> *"Technologies used in the rice industry change rapidly. For example, new technologies such as drone spraying, water-controlled systems, or the application of technology 4.0…. seem to be out of our reach due to the high cost of investment and complexity."* (Rice farm 2's owner).

The data also suggested that the presence of Environmental uncertainty affects the impacts of innovation on performance. When demand or technological uncertainty is present, innovation is less predictive of supply chain performance. For example, any change in market demand will trigger the outcomes of the innovative practices adopted, which will in turn result in changes in supply chain performance. The following comment by the manager of Coffee company 2 was illustrative:

> *"We predicted that demand for organic coffee will increase, and hence invested in the production and development of this coffee brand. However, in contrast to*

our expectations, the sale of organic coffee has been quite low in recent years… This project affected our supply chain performance in terms of cost and efficiency….”

5.5.6 Awareness - New factor identified

5.5.6.1 Case study finding on the importance of Awareness to SCI

The case study data suggested some other factors that may affect innovation, including Government intervention, Complete legal system, and Awareness and Attitude towards innovation of the supply chain members (abbreviated to Awareness). Among these factors, evidence for Awareness and its impact on SCI was strongly evident across the cases (supported by 8 out 10 interviewees). For example, the manager of Rice company 1 explained: *"One of the biggest challenges of adopting innovations is transforming farmers" perception of rice production. It took our company a long time to convince, change and involve them in the sustainable rice project."* The manager also stated that at the beginning the company encountered many difficulties and incurred losses simply due to the poor awareness of farmers, especially of environmental and human health protection. Despite having been well trained, the farmers still maintained their old habits and followed their own working routines, making the innovation processes complex and difficult. Surprisingly, the following comment was made by one of the farmers interviewed (Coffee farmer 2):

> *"The drawbacks of most farmers may be that they usually work spontaneously and focus on immediate benefits, and also are resistant to changing their traditional farming methods… They do not realise the long-term benefits of changes or innovations. When I decided to join Coffee company 2 to grow sustainable coffee, many other farmers tried to prevent me…"*

The manager of Rice company 2 provided evidence that some of its farmers did not follow the guidelines, continuing to, for example, spray pesticide or irrigate a field just 1-2 days before harvest in order to make the harvested paddy heavier, while these practices ought to stop at least 12 days prior to harvesting. These practices significantly affect the quality and safety of rice. Thus, most of the interviewees suggested that, in order to improve the performance of Vietnam‘s agriculture, the first and most important step is to improve farmers‘ perceptions of innovation and its long-term value. However, the manager of Coffee company 2 asserted that, in order to succeed with any innovation strategy, it was imperative to reframe the company‘s own mission, raise awareness and promote employees‘ incentives to make changes.

In short, evidence supporting the importance of Awareness and Attitude in innovation was obtained from all the cases and across most of the interviews. Thus, the factor was recognised as a potential influencing factor on SCI. This finding also finds support in the extant literature, as discussed next.

5.5.6.2 Supporting evidence in the literature

In the literature, several past studies explore the importance of Awareness for different supply chain and operations issues. For example, Mattevi and Jones (2016) have provided evidence that awareness and attitudes towards traceability by SMEs are key elements in the implementation of traceability systems in the UK food supply chain. Zhu et al. (2017) also tested the relationship between regulatory policy awareness and the implementation of environmental supply chain cooperation (ESCC) practices. Drawing on the exchange theory perspective, the research findings indicated that manufacturing firms characterised by higher regulatory awareness are more likely to intensively adopt ESCC practices. Similarly, Gong et al. (2019) investigated stakeholder views and found that customer awareness of a firm‘s sustainability initiatives positively affects their decision-making on product purchase (e.g., being willing to pay a higher price). This results in an increased demand for environmentally friendly products and more market opportunities for firms, which in turns encourages firms to implement sustainable practices. In another example, research by Hegnsholt et al. (2018) indicated that a lack of consumer awareness has increased food loss and led to a waste crisis.

Although a few related previous research studies were identified, there has been a lack of attention to and investigation of Awareness in SCI research. This study fills this gap by empirically testing the impact of Awareness on SCI. The conceptualisation of Awareness, theoretical grounding and hypothesis development for the relationship between Awareness and SCI are provided as follows.

5.5.6.3 Conceptualisation, theoretical grounding and hypothesis development of Awareness

Awareness refers to the awareness of and attitude to SCI of supply chain members, specifically their recognition of the importance and objectives of the adoption of innovation in the supply chain. It also implies a willingness to change and implement the related innovative practices in a serious manner. This conceptualisation of Awareness was drawn from the case study results and adapted from previous work by Mattevi and Jones (2016). Accordingly, the measurement of Awareness is formulated, and includes 3 items capturing critical aspects of the concept: (1) being aware of the importance and benefits of SCI, (2) willingness to change and implement innovative practices, and (3) complying with the processes, procedures and regulations of the innovative practices.

The relationship between Awareness and SCI can be explained based on TCT. From the Transaction cost perspective, awareness can help to reduce opportunistic behaviours by and transaction costs for the supply chain partners during the adoption of innovation. Indeed, Awareness allows the supply chain members to recognise the benefits of innovation adoption (Mattevi & Jones, 2016), thereby motivating them to implement innovative practices in a reliable and ethical manner in order to achieve desired outcomes. This also contributes to a reduction of effort and costs involved in mobilisation, monitoring, training, trial and error, or even possible failure of the innovation. Awareness raised across the supply chain gives its members a greater purpose and more confidence to invest in innovations, leading to increased innovation capabilities. In addition, supply chain partners who have a positive attitude to SCI will be willing to change their current business processes/activities to implement innovations and consider their proactive actions seriously and responsibly (e.g., by following the defined procedures, or complying with regulations). This not only facilitates the smooth and effective implementation of innovative practices within the supply chain but also helps to assure the expected innovation outcomes.

These arguments lead to the following hypothesis:

> **Hypothesis 7:** Awareness is positively associated with SCI.

5.6 A summary of qualitative findings - Towards the revised conceptual model and survey instruments

The qualitative findings provided preliminary validation for the constructs and their relationships, as depicted in the conceptual model. The findings also helped to contextualise and preliminarily confirm the survey instruments while simultaneously delivering insights into the research problem in the real-life context of the Vietnamese agricultural supply chain. More importantly, the case study results enriched the conceptual model by suggesting the importance of Awareness for SCI. Each of these achievements is presented next.

❖ Preliminary confirmation of the conceptual model

The four case studies supported all the constructs in the conceptual model and the relationships between them. The findings provided relatively consistent evidence revealing the direct impacts of Contract, Trust, SCC and SCL on SCI, as well as the relationship between SCI and SCP. Nevertheless, little evidence was found to support the mediating role of Collaboration in the impacts of Contract and Trust on SCI. This relationship will be further examined in the quantitative phase of this research.

❖ Enrichment of the conceptual model

The case studies suggested the importance of Awareness in SCI. The conceptualisation of this factor was then provided, followed by the development of the new hypothesis indicating the positive association between Awareness and SCI, which is theoretically supported by TCT. This hypothesis (H7) was integrated into the revised conceptual model, as portrayed in Figure 5.2. The revised model will be tested in the second phase of this study.

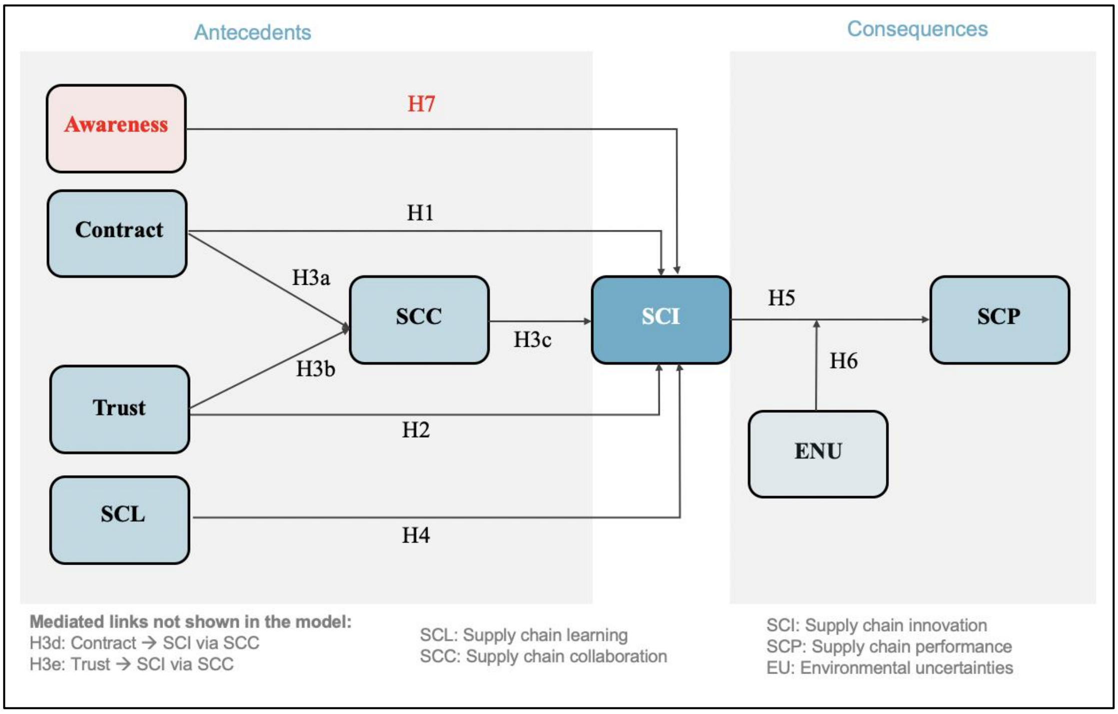

Figure 5.2: The revised conceptual model

❖ Contextualisation and modification of the survey instruments

Most of the component variables measuring the model's constructs were recognised across the cases, except for the measures of SCP. One of the construct's measuring variables (Lead time) was replaced by Conformance to specification of products, as perceived by the interviewees. The contextualisation of the survey instruments also gave rise to some suggestions for the modification of several variables to make them more suitable for the research context. It is noted that three new items measuring the new factor, Awareness, have also been added to the revised survey instrument. Table 5.7 provides more information about the changes to the survey instruments.

Table 5.7: Modification of the survey instruments

Current Construct	Former variables	Revised/new variable
Collaboration	SCC5: Jointly developing strategic objectives	Jointly making decision (e.g., planting, harvesting schedule, input materials) and developing strategies for implementing innovative practices
Performance	SCP 4: Lead times	Products' conformance to specification
Environmental uncertainty	EUN4: It is difficult to implement production technology due to their high degree of technological complexity	It is difficult to implement technologies due to their high cost, investment and requirement of economic of scale
New construct	**New variables added**	
Awareness	AWN1: We are aware that SCI is very important and can bring many benefits to our firm/farms and that of the entire SC	
	AWN2: We are willing to make changes/improvements and implement innovative practices	
	AWN3: We respect and strictly apply innovative practices regarding their processes, procedures and regulations	

❖ In-depth understanding of the conceptual model in the real world

The case studies provided a better understanding of the research problem and the conceptual model in the context of Vietnamese rice and coffee supply chains. The findings first provided insights into many practical innovative practices implemented across the four supply chains. Some patterns were also observed, such as comparative findings with respect to the degree of innovation and level of collaboration and learning occurring within each of the supply chains, which varied according to the sizes of the firms and the characteristics of the supply chains.

In summary, the four objectives of the qualitative phase have been achieved. The insightful findings obtained from the case studies will also benefit the interpretation of the quantitative data analysis results. The revised conceptual model and the survey instruments will be empirically tested using survey data in the next phase of this study (see Chapter 6).

Chapter 6: QUANTITATIVE RESULTS

6.1 Introduction

Chapter 6 presents the quantitative findings obtained from the survey data analysis (phase 2). Initially, a description of the survey sample characteristics is provided in Section 6.2. Prior to the analysis, the assessment of participant bias and common method variance was performed (Section 6.3). Following the quantitative methodology and procedures described in Chapter 4, the measurement model was first examined through a two-stage approach, EFA followed by CFA, to test the reliability, uni-dimensionality and validity of the measurement scales, to ensure the value of the results. Finally, testing of the structural model and hypotheses was conducted. The detailed results for the measurement model and structural model testing are presented in Section 6.4 and Section 6.5, respectively. Figure 6.1 illustrates the structure of this chapter.

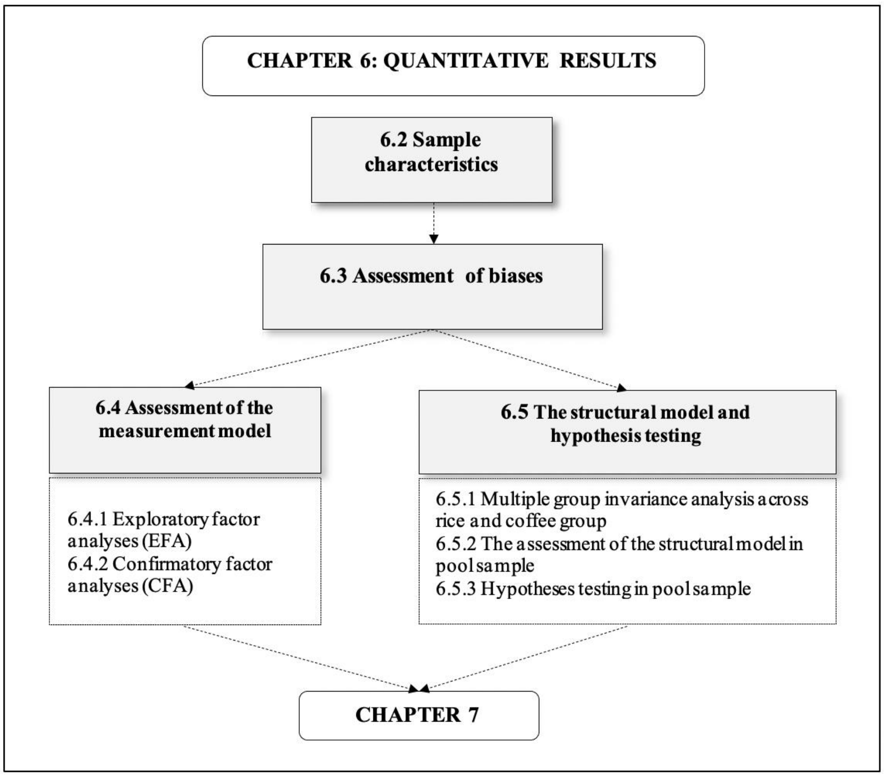

Figure 6.1: The outline of Chapter 6

6.2 Sample characteristics

The data collection for this study was undertaken over a period of five months, specifically, mid-December-late March 2018 (period 1) and November-December 2019 (period 2). It is noted that nearly two-thirds of the data sample (206) was collected during the first period. In order to enlarge the sample size, as per the requirements of the research, the second data collection was conducted with an additional 112 surveys. As a result, a total of 318 completed questionnaires was collected using face-to-face surveys. All the completed questionnaires were satisfactory and included in the data analysis, as the face-to-face surveys help to ensure more accurate responses. This is especially important given that the interviewees in this study, in particular farmers, mostly have a low level of education. The survey sites encompassed three main regions in Vietnam, the Mekong Delta, the Central Highlands and the Southeast, which are major producers of rice and coffee in Vietnam. Table 6.1 describes the distribution of the responses across eleven different provinces in the survey sites.

Table 6.1: Sample structure by the survey sites

Regions	Provinces	Main product	Frequency	Total in group	Percentage in total (%)
The Mekong Delta	Long An	Rice	25	122	38.4
	An Giang		29		
	Can Tho		24		
	Dong Thap		21		
	Kien Giang		23		
The Central Highland	Gia lai	Coffee	35	113	35.5
	Daklak		40		
	Lam Dong		38		
The Southeast	Dong Nai	Rice	9	83	26.1
		Coffee	16		
	Binh Duong	Rice	15		
		Coffee	8		
	Ho Chi Minh	Rice	21		
		Coffee	14		
Total			**318**	**318**	**100**

The data was obtained from rice and coffee supply chains in Vietnam, involving multiple actors in each supply chain. The participants were divided into different groups based on their operating function in the supply chains, comprising growers, processors, traders and exporters of rice and coffee (see Table 6.2). It is noted that a company can operate more than one functions within a supply chain, such as being simultaneously a processor, distributor and exporter of its product. The classification in this study was based on the main/largest operations of each firm. This was clearly explained during the interviews.

Table 6.2: Sample structure by the supply chain functions

Supply chain	Stages in the supply chain	Frequency	Total in group	Percentage in total (%)
Rice	- Grower (farmers/farm owners/Association)	60	167	52.5
	- Processors	69		
	- Trader/exporters/wholesalers/retailers	38		
Coffee	- Grower (farmers/farm owners/Association)	56	151	47.5
	- Roasters	60		
	- Trader/exporters/wholesalers/retailers	35		
Total		**318**	**318**	**100**

Table 6.3 and Table 6.4 provide the structure of the data sample by age and size of the participating firms/farms, respectively. As shown in Table 6.3, the majority of the participating firms/farms were established before 1999, accounting for 81.4%. Only 4.7% of the sample were relatively new firms/farms that started their businesses after 2010. This is reflective of the situation in the Vietnamese agricultural industry, where most farming businesses have been established for many years. The firm size is represented by the number of employees, classified into four groups: (i) less than or equal to 10 employees (very small/micro), (ii) 11-100 employees (small), (iii) 101-200 employees (medium), and (iv) more than 200 employees (large). As shown in Table 6.4, nearly 60% of the participants came from very small and small-sized firms (less than 100 employees). This can be explained by the small and fragmented nature of production in Vietnamese agriculture.

Table 6.3: Sample structure by firm age

	Frequency	Percentage	Cumulative Percentage
Before 1990	131	41.2	41.2
From 1991–1999	128	40.3	81.4
From 2000–2009	44	13.8	95.3
From 2010	15	4.7	100.0
Total	**318**	**100.0**	

Table 6.4: Sample structure by firm size

	Frequency	Percentage in groups	Cumulative Percent
≤ 10 employees	49	15.4	15.4
11-100 employee	136	42.8	58.2
101-200 employee	98	30.8	89
More than 200 employees	35	11	100
Total	**318**	**100.0**	

The ownership structure of the participating firms was also considered in this study. As presented in Table 6.5, the participating firms were primarily characterised as either being under sole proprietorship or a private limited company, together accounting for 86.5% of the sample.

Table 6.5: Sample structure by firm ownership structure

Ownership	Frequency	Percentage	Cumulative Percentage
Sole proprietorship	166	52.2	52.2
Private limited company	109	34.3	86.5
Partnership	31	9.7	96.2
Others (e.g., State-owned enterprise, association)	12	3.8	100
Total	318	100	

Table 6.6 shows the profile of the surveyed respondents in relation to their age, gender, education and working experience. The data indicates that most respondents were aged 35–54 (74.2%), with the rest aged between 18–34 (7.2%) and older than 55 (17.6%). The respondents were predominantly male (62.9%), compared to female (37.1%). In relation to education, 46.5% of respondents held university degrees and 48.7% had primary/secondary education. This partially reflects the agricultural workforce in Vietnam, which requires a lower level of education than other sectors, especially given that 36.5% of respondents were farmers or farm owners and 15.4% were from very small farms or family-owned processing firms, which are mostly operated by people with farming experience. Over half of the respondents (61.9%) had more than 10 years‘ experience in their firms, while 31.8% had more than five years‘ experience. This could be because most interviewed businesses are long- established, as mentioned earlier, and because respondents were selected from the most experienced personnel in the firms.

Table 6.6: Overall profile of the respondents

Variables	Categories	Frequency	Percentage
Age	18–34	23	7.2
	35–44	83	26.1
	45–54	153	48.1
	55–64	56	17.6
	Over 65	3	0.9
Gender	Male	200	62.9
	Female	118	37.1
Education	Primary/Secondary	155	48.7
	Undergraduate	148	46.5
	Postgraduate	5	1.6
	Other	10	3.1
Number of years in the firm	0–2 years	3	0.9
	3–5 years	17	5.3
	6–9 years	101	31.8
	More than 10 years	197	61.9

6.3 Assessment of biases

As mentioned in Chapter 4, before commencing the analysis, the assessment of participant bias and common method variance was performed. Specifically, since the data collection was undertaken over two periods of time nearly a year apart, the bias between the two periods was assessed. Following Flynn et al. (2010) and (G.-C. Wu, 2013), the size (the number of employees) of the responding firms was obtained, and the responding firms surveyed in each period were compared in relation to this major attribute using t-test. In this test, Levene's test was used to determine whether the assumption of homogeneity of variance, which is an assumption that variance is equal across the comparison groups, is violated. A p-value of Levene‘s test of less than 0.05 indicates a violation of the assumption. As shown in Table 6.7, the p-value of Levene‘s test in this study is greater than 0.05, indicating that the variance between the two groups (two periods of the data collection) is equivalent. Then, t-statistics for Equality of means was considered to determine any difference in means between the periods. In this respect, the p-value of t-test in this study is greater than 0.05. This indicates that there was no significant difference in means between the two periods of data collection.

Table 6.7: Differences between means of variables across two periods of collection data

Variable	Levene test for Homogeneity	t-test
Number of employees	0.146	-0.776
	(0.703)	(0.439)

Note: Values in brackets are *p*-values (2-tailed)

Next, the possibility of common method variance was assessed using Harman's single factor test (Podsakoff et al., 2003). According to Podsakoff et al. (2003), the measures in which a single factor accounts for a majority of the variance can be considered as biased. In this study, a factor analysis (unrotated solution) of all variables yielded nine factors with Eigenvalues being greater than 1, explaining 72.222% of a total variance. In addition, the first factor explained only 30.644% (less than 50%) of the variance, which is not a majority of the total variance (see Table 6.8). Since no single factor accounting for most of the variance emerged, this study illustrates a non-significant common method variance problem.

Table 6.8: Total Variance Explained for the Harman's Single Factor Test.

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.542	32.158	32.158	11.951	30.644	30.644
2	3.306	8.476	40.634			
3	2.478	6.355	46.988			
4	2.239	5.741	52.729			
5	1.794	4.599	57.328			
6	1.725	4.423	61.751			
7	1.540	3.949	65.700			
8	1.311	3.361	69.061			
9	1.233	3.161	72.222			

6.4 Assessment of the measurement model

Prior to the hypothesis testing, the measurement model was tested for the reliability, uni-dimenisonalilty and validity of the scales. As mentioned in the Methodology Chapter, the measurement model was assessed through a two-stage approach: EFA followed by CFA. EFA was conducted in SPSS to explore the structure of the scales and to increase the internal consistency of the scales. Then, the refined scales from the EFA results were further tested with CFA, using AMOS for the confirmation and validation of the final scales, before fitting into the hypothesised structure testing. The next section describes these steps and results in detail.

6.4.1 EFA results

As discussed in Chapter 4 (see Section 4.6.4.2), the EFA in this study, using Principal axis factoring with Promax rotation, was carried out through two hierarchical steps: (i) EFA for individual scale and (ii) EFA for all scales combined (or the whole measurement model). The appropriateness of the data for EFA was initially examined before the EFA was conducted. Details of these steps are as follows:

6.4.1.1 Testing the appropriateness of data for EFA

For testing the sampling adequacy for EFA, the Kaiser-Meyer-Olkin (KMO) (KMO $\geq$ 0.5) and Bartlett's test (Sig. $<$ 0.05) were conducted (Hair et al., 2010; Williams et al., 2010). Table 6.9 shows the results of these tests. From the table, KMO statistic was 0.935, or greater than 0.5, which is satisfactory for factor analysis. In addition, the large value of Chi-square of Barlett's Test (6916.03), with its significance level (p =0.000) of less than 0.05, indicates the appropriateness of data for EFA.

Table 6.9: KMO and Bartlett's test results

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.935
Bartlett's Test of Sphericity	Approx. Chi-Square	6916.031
	df	528
	Sig.	0.000

6.4.1.2 EFA for individual scales

In this stage, the methods and procedures for EFA defined in the Methodology chapter (recall Table 4.5 in Chapter 4) were applied to each of the nine constructs to assess the uni-dimensionality, convergent validity and reliability of the measurement scale of each construct. First, a scale is concerned as empirically uni-dimensional when only a single factor is extracted from the factor analysis (Garver & Mentzer, 1999; Hair et al., 2010). Second, for the convergent validity, the factor loading (factor loading $\geq$ 0.5) and Total

Variance Explained (variance extracted ≥ 0.5) was assessed (Anderson & Gerbing, 1988; Garver & Mentzer, 1999; Hair et al., 2010). Table 6.10 provides the EFA and reliability test results of the nine constructs. As shown in the table, there were eight out of nine scales, satisfying all the aforementioned criteria and not requiring modification: Trust (4 items), Contract (3 items), Collaboration (5 items), Learning (5 items), Awareness (3 items), SCI (9 items), Demand uncertainty (2 items) and Technology uncertainty (2 items). In particular, the results show that only one factor was extracted for each of the scales from the factor analysis. In addition, the variance explained by the extracted factor ranges from 60.93% to 95.06%, which is greater than 0.5, and the factor loadings are all above the threshold of 0.50. These results indicate that all of the eight scales listed above are unidimensional and convergent at this preliminary stage.

Once the uni-dimensionality and convergent validity of the scales were established, the reliability of the scales was assessed using Cronbach Alpha. As a criterion for this reliability assessment, the scale for each construct must achieve a minimum alpha of 0.70 and items with low item-total correlation coefficients (<0.50) were eliminated (Hair et al., 2010). As shown in Table 6.10, the Cronbach alpha values of these nine scales are all well above the threshold of 0.70 (ranging from 0.776 to 0.948). The item-total correlation values, which range from 0.544 to 0.901, satisfy the threshold of 0.50 or greater. Therefore, all items comprising these scales were retained.

Table 6.10: EFA and reliability test result

Construct / Items	Factor loading	% Variance Extracted	Eigenvalue	Item-total correlation	Cronbach Alpha
Trust		73.69	2.95		0.880
TRU1_12	0.875			0.797	
TRU2_13	0.832			0.765	
TRU3_14	0.767			0.713	
TRU4_15	0.749			0.698	
Contract		78.74	2.36		0.863
CON1_16	0.806			0.729	
CON2_17	0.877			0.775	
CON3_18	0.794			0.723	
Collaboration		60.93	3.05		0.839
COL1_19	0.727			0.652	
COL2_20	0.704			0.634	
COL3_21	0.738			0.659	
COL4_22	0.706			0.635	
COL5_23	0.701			0.632	
Learning		74.30	3.72		0.913
LEA1_24	0.787			0.747	
LEA2_25	0.811			0.768	
LEA3_26	0.756			0.720	
LEA4_27	0.857			0.808	
LEA5_28	0.906			0.851	
Awareness		69.16	2.08		0.776
AWA1_29	0.739			0.617	
AWA2_30	0.719			0.604	
AWA3_31	0.741			0.618	
SCI		64.33	5.79		0.930
INN1_32	0.744			0.715	
INN2_33	0.860			0.823	
INN3_34	0.795			0.764	
INN4_35	0.778			0.750	
INN5_36	0.848			0.814	
INN6_37	0.820			0.789	
INN7_38	0.792			0.762	
INN8_39	0.739			0.706	
INN9_40	0.564			0.544	
Demand Uncertainty		95.06	1.90		0.948
UNC1_47	0.949			0.901	
UNC2_48	0.949			0.901	
Technology Uncertainty		89.92	1.80		0.883
UNC3_49	0.893			0.798	
UNC4_50	0.893			0.798	

The other scale measuring SCP (6 items), required some refinements, as shown in Table_6.11. This SCP scale met most of the requirements: only one factor extracted with variance explained 63.99%; the Cronbach alpha being well above the threshold of 0.70. However, the factor loading coefficient and the item-total correlation of one of its items were below the acceptable thresholds of 0.50 or greater. To explain further, the item PER6_46 (*You have increased customer service level record to your supply chain partners*) has low factor loading (0.326) and low item-total correlation (0.311). This item was therefore deleted.

Table 6.11: Results of uni-dimensionality and reliability test – item deleted

Items	Original scale		Refined scale	
	Factor loading	Item-total correlation	Factor loading	Item-total correlation
SC performance				
PER1_41	0.779	0.728	0.785	0.743
PER2_42	0.837	0.784	0.835	0.788
PER3_43	0.838	0.781	0.844	0.798
PER4_44	0.824	0.772	0.821	0.776
PER5_45	0.840	0.791	0.833	0.788
PER6_46	***0.326***	***0.311***	*eliminated*	*eliminated*
Variance extracted	63.99%		74.26%	
Eigenvalue Cronbach	3.84		3.71	
Alpha	0.884		0.912	

In summary, after EFA for individual scales, eight scales were immediately accepted, and one scale was refined by deleting one of its items (PER6_46). The remaining 38 items for the 9 scales were retained and put into the combined EFA.

6.4.1.3 EFA for the full measurement model

After establishing the uni-dimensionality, convergence and reliability of the individual scales, all 38 items were jointly subjected to a common factor analysis. The results of this procedure are presented in Table 6.12. As shown in the table, the factor loadings of 37 out of 38 items varied from 0.619 to 0.966, which is higher than the threshold of 0.50. The exception was item INN9_40, which has low factor loading (≤ 0.50) and was therefore eliminated.

Table 6.12: Result of joint factor analysis for nine scales

	Factor								
	1	2	3	4	5	6	7	8	9
TRU1_12					0.852				
TRU2_13					0.779				
TRU3_14					0.642				
TRU4_15					0.892				
CON1_16						0.821			
CON2_17						0.864			
CON3_18						0.835			
COL1_19				0.831					
COL2_20				0.623					
COL3_21				0.761					
COL4_22				0.632					
COL5_23				0.641					
LEA1_24		0.748							
LEA2_25		0.789							
LEA3_26		0.809							
LEA4_27		0.858							
LEA5_28		0.934							
AWA1_29								0.751	
AWA2_30								0.741	
AWA3_31								0.713	
INN1_32	0.710								
INN2_33	0.775								
INN3_34	0.619								
INN4_35	0.641								
INN5_36	0.863								
INN6_37	0.656								
INN7_38	0.787								
INN8_39	0.945								
INN9_40	***0.308***								
PER1_41			0.787						
PER2_42			0.861						
PER3_43			0.826						
PER4_44			0.838						
PER5_45			0.823						
UNC1_47							0.964		
UNC2_48							0.935		
UNC3_49									0.966
UNC4_50									0.849

After the item INN9_40 was deleted, the same procedure of the joint EFA (for 37 items) was repeated and the new results are reported in Table 6.13. At this stage, further assessments underlying the uni-dimensionality, convergent and discriminant validity of the scales were made under the following criteria: (i) Uni-dimentionality: no item highly loads on more than one factor (one item measures only one construct); (ii) Convergent validity: all items comprising a scale must highly load on one factor that represents their underlying construct (high loadings of all items of a construct); (iii) discriminant validity (no factor consists of two sets of items highly loading on it) (Anderson & Gerbing, 1988; Garver & Mentzer, 1999; Hair et al., 2010). The joint EFA results in Table 6.13 show that there were nine factors extracted which jointly explain 74.619% of the total variance. The factor loadings of each of the 37 items vary from 0.606 to 0.969, which are higher than the threshold of 0.50. Moreover, no item loads significantly on more than one factor and all items load significantly on one factor representing its latent construct only. These results support a preliminary justification of the reliability, uni-dimensionality, convergent and discriminant validity of the scales. These scales were further assessed and validated using CFA in the next section. To this end, this study provides an integrated framework that summarises different stages, techniques and related criteria, as well as the key results of the EFA, as depicted in Figure 6.2.

Table 6.13: Result of joint factor analysis for seven scales after deleting INN9_40

	Factor								
	1	2	3	4	5	6	7	8	9
TRU1_12					0.851				
TRU2_13					0.775				
TRU3_14					0.642				
TRU4_15					0.888				
CON1_16						0.800			
CON2_17						0.875			
CON3_18						0.820			
COL1_19				0.830					
COL2_20				0.625					
COL3_21				0.767					
COL4_22				0.633					
COL5_23				0.642					
LEA1_24		0.748							
LEA2_25		0.789							
LEA3_26		0.808							
LEA4_27		0.858							
LEA5_28		0.934							
AWA1_29								0.750	
AWA2_30								0.740	
AWA3_31								0.712	
INN1_32	0.698								
INN2_33	0.767								
INN3_34	0.606								
INN4_35	0.628								
INN5_36	0.849								
INN6_37	0.635								
INN7_38	0.766								
INN8_39	0.951								
PER1_41			0.790						
PER2_42			0.863						
PER3_43			0.825						
PER4_44			0.840						
PER5_45			0.821						
UNC1_47							0.969		
UNC2_48							0.931		
UNC3_49									0.963
UNC4_50									0.850

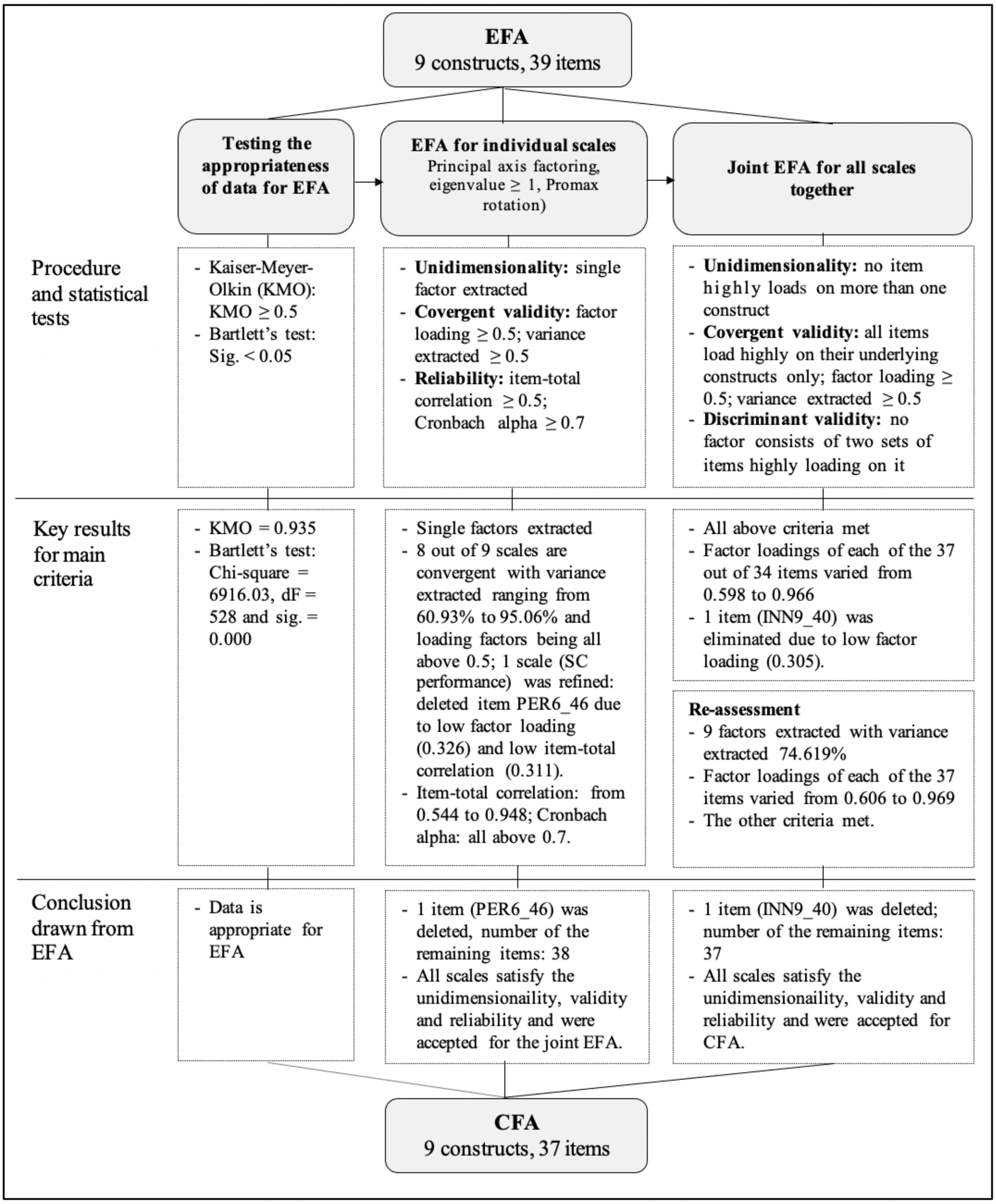

Figure 6.2: EFA procedures and results in this study

6.4.2 CFA results

The refined scales adopted from EFA were further assessed and confirmed by means of CFA using AMOS. Following the procedures developed for CFA, as presented in Chapter 4 (recall Table 4.6), a series of CFA tests was undertaken to re-examine the uni-dimensionality, reliability, convergent validity and discriminant validity of the scales. Being similar to EFA, CFA in this study consists of 2 stages: CFA for individual scales followed by CFA for all scales together. The results of each stage are discussed next.

6.4.2.1 CFA for individual scales

Exceptional scales excluded from CFA

Before presenting CFA results, it is important to note that there were two exceptional scales in the CFA model. Specifically, out of nine scales after EFA, the two scales measuring the moderating factors (Demand uncertainties and Technological uncertainties), were excluded from the CFA model. This was because these scales that contained only two items in each scale can encounter identification problem in CFA. However, when a scale has been well established in the existing literature and empirically tested in many previous studies, it can contain two items (Gosling et al., 2003). In addition, according to Worthington and Whittaker (2006) and Yong and Pearce (2013), two-item scales are considered reliable when their items are highly correlated with each other, but relatively uncorrelated with other items. As evident from the EFA results, the two factors satisfy these criteria. Indeed, the items of each factor together load significantly on the factor (see Table 6.13), along with their high Cronbach' alpha coefficients (see Table 6.10). These jointly support the reliability and validity of the moderating scales regardless of CFA consideration.

Over-identified and just-identified model

Among the seven scales measuring the dependent and independent factors (Trust, Contract, Collaboration, Learning, Awareness, SCI and SCP) that were put into the CFA model, two three-item scales, namely Contract and Awareness, were considered in just-identified models. Meanwhile, the other scales with more than three items were evaluated in an over-identified model (Little, 2013). In the context of SEM, an over-identified model can be wrong to some degree that indicates how good/bad the hypotheses are given available data. In contrast, a just-identified (or saturated) model has zero degree of freedom (df) and always fits data perfectly, thus the model can never be rejected/false (Bagozzi & Heatherton, 1994; Bollen, 1989; Byrne, 2001; Little, 2013). There are different approaches for dealing with this issue of the just-identification model. This study adopted the approach suggested by Bagozzi and

Heatherton (1994). The approach is used to test how well a single-factor model fits the data under the constraint, in which the three factor loadings (or selected subsets of two) are set to be equal. This helps to yield the chi-square and set the degree of freedom equal to 2 (or df = 1 if a pair of loadings is constrained to be equal). Accordingly, this approach was applied to the two-factor models (Contract and Awareness) with three items of each, and the unstandardised factor loadings of the two items in each are set to be equal.

The results of CFA for individual scales in both the over-identified and just-identified models are presented in Table 6.14. The table provides a summary of the estimates of the model and its fit indexes. The CFA results indicate that all the scales were satisfactory regarding the uni-dimensionability, reliability and convergent validity, as discussed in detail below:

Uni-dimensionality

The uni-dimensionality of the scale was examined by the overall fit of the model, which is determined based on different indexes: (i) Chi-square/df (≤ 3), (ii) Tucker-Lewis index (TLI) (≥ 0.90), (iii) Comparative fit indexes (CFI) (≥ 0.90), and (iv) Root mean square error approximation (RMSEA) (≤ 0.06 for a good fit or between 0.06 and 0.08 for an acceptable fit) (Arbuckle & Wothke, 1999; Garver & Mentzer, 1999; Hair et al., 2010; Hu & Bentler, 1999). As shown in Table 6.14, all the fit indexes (Chi-square/df, TLI, CFI and RMSEA) of these factors indicated a good fit or acceptable fit of the model. This confirmed the uni-dimensionality of the scales.

Reliability

The reliability of a scale in CFA was evaluated based on the Composite reliability at a value of ≥ 0.7 (Hair et al., 2010; Selltiz et al., 1976). In this regard, the composite reliability values were all well above 0.70, ensuring the reliability of the scales.

Convergent validity

The convergent validity of individual scales can be achieved under two conditions: (i) a satisfactory level of the model fit; (ii) statistically significant regression coefficients (≥ 0.7) (Garver & Mentzer, 1999; Hair et al., 2010; Kline, 2015). As shown in Table

6.14, the standardised regression coefficients of all items of the seven constructs, ranging from 0.700 to 0.904, were equal to or higher than the minimum accepted value of 0.7. The CFA results also indicated a good or acceptable model fit, as mentioned earlier. The combination of these results confirmed the convergent validity of the scales.

As a result, the uni-dimensionality, reliability and convergent validity of all seven scales were indicated and no refinement was required before proceeding to the second step of the CFA.

Table 6.14: CFA Results of individual scales

Construct / Items	Regression coefficient Unstandardized	Standardized	Standard Error	p	χ^2 (p)	dF	χ^2/dF	TLI	CFI	RMSEA	Composite Reliability
SCALES WITH OVER-IDENTIFIED MODELS											
Trust					3.304 (0.192)	2	1.652	0.994	0.998	0.045	0.882
TRU1_12	1.000	0.873	Na								
TRU2_13	0.860	0.827	0.049	***							
TRU3_14	0.788	0.770	0.050	***							
TRU4_15	0.721	0.755	0.047	***							
Collaboration					14.793 (0.011)	5	2.959	0.965	0.983	0.079	0.839
COL1_19	1.000	0.731	Na								
COL2_20	1.035	0.700	0.092	***							
COL3_21	1.091	0.741	0.092	***							
COL4_22	0.950	0.704	0.084	***							
COL5_23	1.083	0.700	0.096	***							
Learning					12.190 (0.032)	5	2.438	0.986	0.993	0.067	0.914
LEA1_24	1.000	0.787	Na								
LEA2_25	1.059	0.815	0.067	***							
LEA3_26	0.973	0.762	0.067	***							
LEA4_27	1.083	0.852	0.064	***							
LEA5_28	1.179	0.904	0.065	***							

Construct / Items	Regression coefficient		Standard Error	p	χ^2 (p)	dF	χ^2/dF	TLI	CFI	RMSEA	Composite Reliability
	Unstandardized	Standardized									
SC Innovation					29.501	20	1.475	0.992	0.995	0.039	0.933
INN1_32	0.798	0.743	Na	***	(0.078)						
INN2_33	1.209	0.866	0.076	***							
INN3_34	1.106	0.793	0.077	***							
INN4_35	1.135	0.775	0.081	***							
INN5_36	1.125	0.849	0.072	***							
INN6_37	1.216	0.812	0.082	***							
INN7_38	1.032	0.784	0.072	***							
INN8_39	1.074	0.754	0.079	***							
SC Performance					11.635	5	2.327	0.987	0.994	0.065	0.913
PER1_41	1.000	0.786	Na		(0.040)						
PER2_42	1.156	0.833	0.072	***							
PER3_43	1.096	0.842	0.067	***							
PER4_44	1.232	0.824	0.077	***							
PER5_45	1.042	0.833	0.065	***							
SCALES WITH JUST-IDENTIFIED MODELS											
Contract					2.531	1	2.531	0.990	0.997	0.069	0.866
CON1_16	0.954	0.829	0.055	***	(0.112)						
CON2_17	0.954	0.854	0.055	***							
CON3_18	1.000	0.796	.Na								
Awareness					1.613	1	1.613	0.993	0.998	0.044	0.777
AWA1_29	1.019	0.704	0.089	***	(0.204)						
AWA2_30	1.019	0.749	0.089	***							
AWA3_31	1.000	0.740	Na								

Note: *** significant at $p < 0.001$ Na: non-applicable because the unstandardized regression coefficient is 1

6.4.2.2 CFA results for the full measurement model

In this step, the model of 7 constructs and 33 observed variables were subjected to CFA to evaluate the convergent and discriminant validity and reliability of the measurement model. The results from Table 6.14. in accordance with Figure 6.3 indicate the good fit of the measurement model.

Convergent validity

With regard to testing the convergent validity of the full model, the Average Variance Extracted (AVE) was calculated with expected value ≥ 0.5 (Hair et al., 2010) and the model fit was assessed. The 6.15 provides information about the fit indexes of the measurement model. The results showed a good fit of the measurement model. In addition, the calculated AVE values for the seven constructs were all above 0.5. It is emphasised that five of the seven constructs have AVE greater than 0.6, indicating good convergent validity for the model. The AVE values and other results of the validity and reliability tests of the measurement model can be found in Table 6.16.

Table 6.15: Fit Indexes for the Measurement Models

Fit Indexes	Estimates	Suggested Value
Chi-square/df	1.507	< 3 (Hayduk, 1987)
TLI	0.960	≥ 0.90 (Hair et al., 1998)
CFI	0.964	≥ 0.90 (Hu and Bentler, 1999)
RMSEA	0.040	≤ 0.08 (Hu and Bentler, 1999)

Table 6.16: Validity and Reliability of the Measurement Model

	AVE	**MSV**	**ASV**	CONT	INNO	LEAR	PERF	COLL	TRUS	AWAR
CONT	0.683	0.294	0.167	**0.827**						
INNO	0.636	0.508	0.334	0.474	**0.798**					
LEAR	0.682	0.364	0.152	0.248	0.603	**0.826**				
PERF	0.679	0.294	0.179	0.542	0.524	0.278	**0.824**			
COLL	0.511	0.508	0.226	0.426	0.713	0.395	0.394	**0.715**		
TRUS	0.651	0.462	0.244	0.458	0.680	0.451	0.513	0.495	**0.807**	
AWAR	0.537	0.172	0.076	0.172	0.415	0.227	0.088	0.332	0.286	**0.733**

AVE: Average Variance Extracted
MSV: Maximum Shared Variance
ASV: Average Shared Variance
CONT, INNO, LEAR, PERF, COLL, TRUS and AWAR are the codes of the seven constructs

Discriminant validity

In order to test for discriminant validity, in addition to AVE, additional values need to be computed, including Average Shared Variance (ASV) and Maximum Shared Variance (MSV). A model achieves discriminant validity when it satisfies the following three conditions: (i) the AVE needs to be higher than the MSV; (2) the AVE also needs to be higher than the ASV; and (3) the AVE needs to have a square root higher than the correlations between inter-constructs (Hair et al., 2010). As evident from Table 6.16, the MSVs and ASVs of all seven constructs were lower than their respective AVEs. In addition, the square root values of the AVEs were all higher than the correlations between inter-constructs. These confirmed that all seven constructs demonstrated adequate discriminant validity.

Figure 6.3 illustrates overall CFA results of the measurement model from AMOS. A summary of the procedures and results of the CFA is also depicted as Figure 6.4. As clearly shown in Figure 6.4, CFA results confirmed that all the seven scales and the measurement model are satisfactory in terms of uni-dimensionality, reliability, convergent and discriminant validity, and no further refinement of the scales is required in this stage after the EFA.

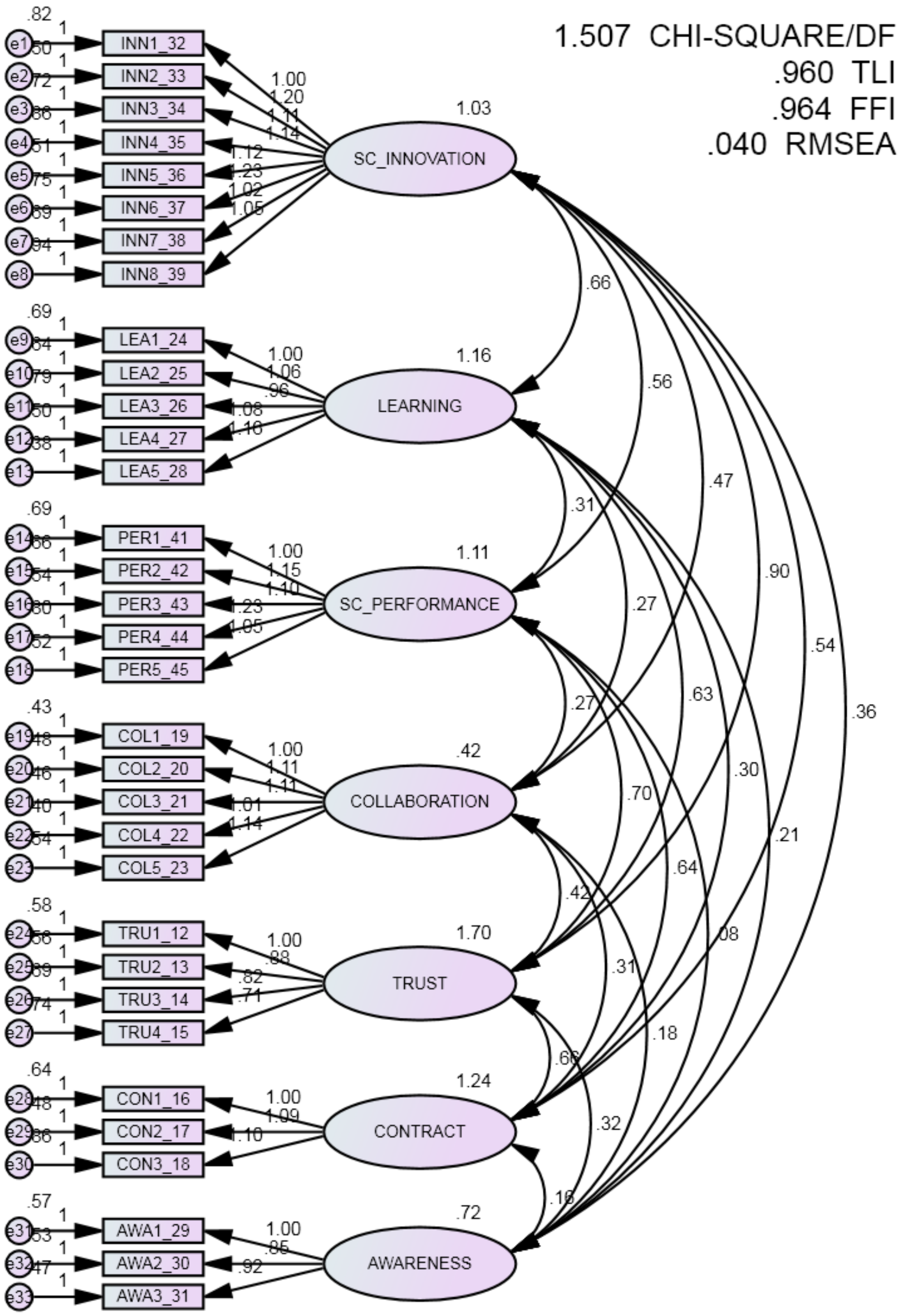

Figure 6.3: CFA results of The Measurement Model

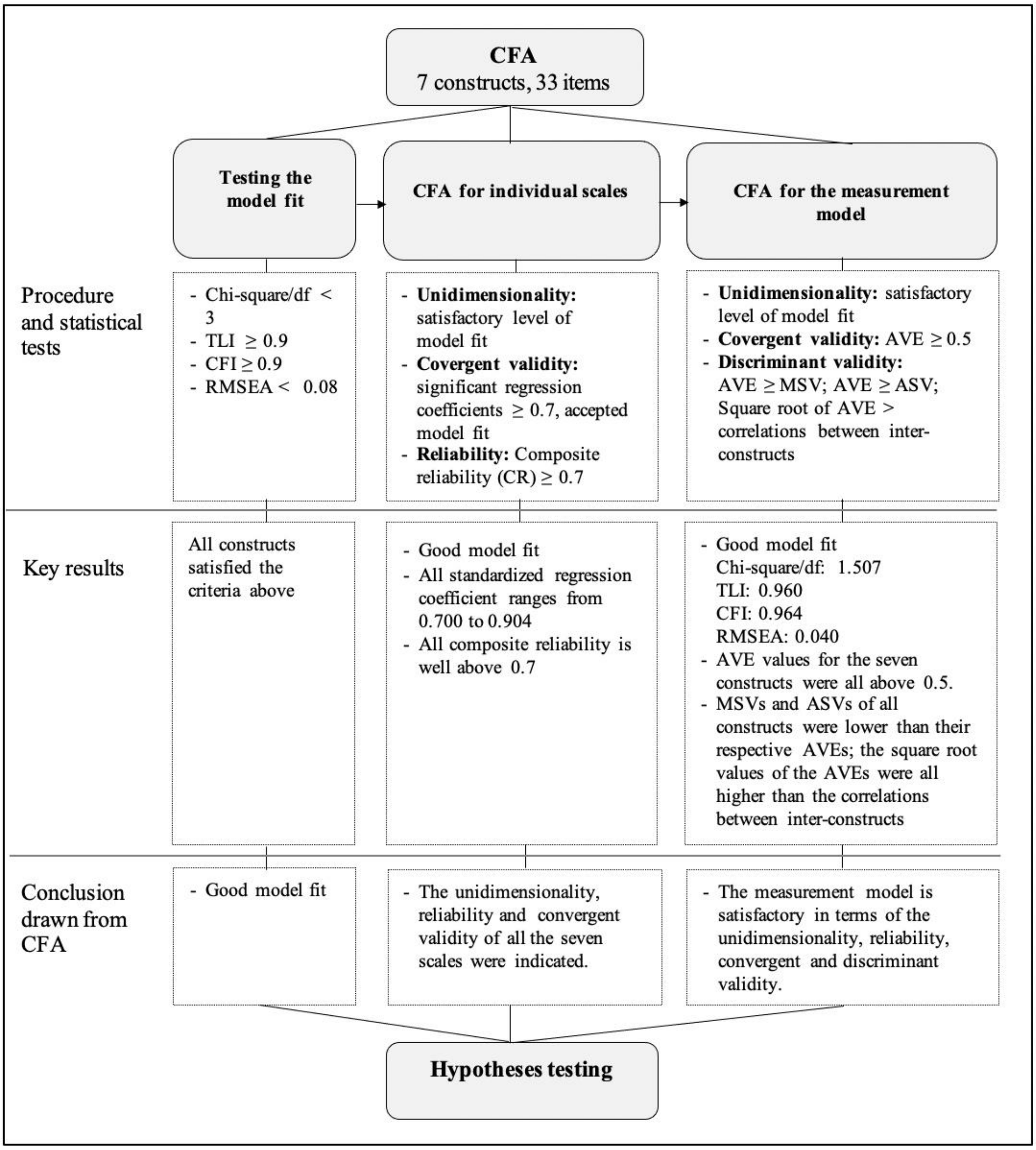

Figure 6.4: CFA procedures and results in this study

6.5 The structural model and hypothesis testing

Having been validated through the results of EFA and CFA, the measurements were used to test the hypothesised relationships included in the structural model. For hypothesis testing, multiple statistical analyses were employed, including: (1) multiple group analysis was used to assess the variance between the two sets of sub-samples (rice and coffee) in order to determine the aggregation of the sub-samples, (2) SEM analysis was conducted to test the direct relationships between the constructs of the model, (3) bootstrapping analysis was performed to examine the mediating impacts of SCC on the relationships between Contract, Trust and SCI, (4) multiple group analysis was conducted to investigate the moderating impacts of ENU on the SCI-SCP relationship. These procedures are presented next.

6.5.1 Multiple group invariance analysis across rice and coffee group

In this study, as the empirical data was collected from two different groups of respondents belonging to the rice and coffee supply chains, prior to testing the structural model and hypotheses, a multi-group invariance analysis was performed to examine the possibility of the aggregation of the two sub-samples of rice and coffee. Multi-group invariance analysis is commonly used to test differences between similar models for different groups of respondents (Hair et al., 2010). The technique helps to assess whether two (or more variables) have the same or different relation across groups (MacKinnon, 2011). The technique was therefore performed to examine whether the measurement and the model paths varied across the rice and coffee groups. In other words, this step was intended to test the measurement and structural equivalence of the proposed model, which helped to validate the aggregation of the two groups of the data sample. This study followed the approach used by Byrne (2010), Doll et al. (2004), and Hair et al. (2010) in conducting the multi-group analysis. The test consists of two steps, as shown below:

6.5.1.1 Step 1-Measurement invariance testing

The first step was to verify the measurement invariance (measurement equivalence) across the rice and coffee groups using CFA. In this step, the appropriateness of the model was initially examined based on the model fit indices, including chi-square to degrees of freedom ratio (≤ 3.0), RMSEA (≤ 0.08), and CFI (≥ 0.9) (Byrne, 2010).

Then the unconstrained model was compared to the constrained model to determine the cross-group validity of the measurement model. For the unconstrained model, no equality constraints were specified across groups. For the constrained model, the study imposed equality constraints on factor loadings for all independent and dependent variables across groups. A chi-square difference between the unconstrained and constrained model was used to indicate whether the loadings were invariant across the rice and coffee groups. Table 6.17 reports the results of the measurement invariance tests based on the above procedure. The measurement model in both the rice and coffee groups exhibited an acceptable level of model fit. This means that the measurement model appeared valid in both sub-samples taken separately. When the unconstrained model was compared with the constrained model, the chi-square difference was 16.361 with 26 degrees of freedom and a p-value of 0.927 (≥ 0.05), which is not statistically significant. Thus, the measurement model was invariant for respondents from the Rice and Coffee groups.

Table 6.17: Measurement Invariance Analysis across Rice and Coffee groups

Model tested	χ^2	*df*	χ^2/df	RMSEA	CFI	Δ*df*	$\Delta\chi^2$	*p*
Fit indices in CFA								
Measurement model for Rice	604.210	474	1.275	0.041	0.960			
Measurement model for Coffee	629.727	474	1.329	0.044	0.957			
Measurement Invariance								
Unconstrained model	1202.851	948	1.269	0.029	0.962			
Constrained model (Factor loadings)	1219.213	974	1.252	0.028	0.963	26	16.361	0.927

6.5.1.2 Step 2 - Structural invariance testing

After the measurement invariance was validated, a similar procedure was performed to evaluate the invariance of the structural model (model paths) across the two groups using SEM. Initially, the structural model fit was examined. The unconstrained model was estimated with path estimates, which were calculated separately for each group. The constrained model was estimated through constraining all of the structural paths to be equal across the two groups. Then the chi-square difference was conducted to check for statistical significance. If the two models are statistically significant, the structural model is invariant from the rice and coffee groups. The model fit indices are provided in Table 6.18 and the structural path estimates are presented in Table 6.19. The results show a good model fit of the structural model for both the rice and coffee samples. Comparing the unconstrained model to the constrained model, the chi-square difference was 17.423 with 34 degrees of freedom, which is not statistically significant with a p-value of 0.992. It can be concluded that the structural model is invariant from the two groups, providing evidence of structural equivalence across the rice and coffee groups.

Table 6.18: Structural Invariance Analysis across Rice and Coffee groups

Model tested	χ^2	*df*	χ^2/df	RMSEA	CFI	Δdf	$\Delta\chi^2$	*p*
Fit indices in SEM								
Measurement model for Rice	648.983	481	1.349	0.046	0.947			
Measurement model for Coffee	680.993	481	1.416	0.050	0.944			
Structural Equivalence								
Unconstrained model	1282.552	962	1.333	0.032	0.950			
Constrained model (path estimates)	1299.975	996	1.305	0.031	0.953	34	17.423	0.992

Table 6.19: Path Estimates for constrained and unconstrained structural models

Path	Unconstrained estimates				Constrained estimates	*p*
	Rice	*p*	Coffee	*p*		
Contract → SC Innovation	0.123	0.024	0.045	0.437	0.089	0.023
Trust → SC Innovation	0.385	***	0.329	***	0.360	***
Contract → SC Collaboration	0.092	0.142	0.184	***	0.150	***
Trust → SC Collaboration	0.340	***	0.294	***	0.308	***
SC Collaboration → SC Innovation	0.452	***	0.645	***	0.523	***
SC Learning → SC Innovation	0.221	***	0.233	***	0.225	***
SC Innovation → SC Performance	0.610	***	0.664	***	0.635	***
Awareness → SC Innovation	0.192	0.016	0.161	0.088	0.177	0.004

The above conclusions have been drawn for the invariance testing of the structural model (a set of structural paths) as a whole. However, the set of structural paths that appear invariant as a whole might include individual structural paths that are non-invariant. To address this limitation, this study followed the approach proposed by Doll et al. (1998) to further analyse the multi-group invariance. Accordingly, a two-group model in which the equality constraints were imposed for each structural path estimate across the two groups was executed, while at the same time the chi-square values were recorded. Then the equality constraints for the structural path estimates were released one by one. Next, statistical significance was evaluated based on the Chi-square difference. As evident from Table 6.20, no path estimate was statistically significant across the rice and coffee groups. This conclusion is in line with those reported previously.

Table 6.20: Invariance testing for individual path in the structural model across rice and coffee groups

Model tested	χ^2	*df*	χ^2/df	RMSEA	CFI	Δdf	$\Delta\chi^2$	*p*
Constrained model (all invariance)	1299.975	996	1.305	0.031	0.953			
Contract → SC Innovation (path invariance relaxed)	1299.765	995	1.306	0.031	0.953	1	0.210	0.647
Trust → SC Innovation (path invariance relaxed)	1299.965	995	1.306	0.031	0.953	1	0.010	0.920
Contract → SC Collaboration (path invariance relaxed)	1298.255	995	1.305	0.031	0.953	1	1.720	0.190
Trust → SC Collaboration (path invariance relaxed)	1299.493	995	1.306	0.031	0.953	1	0.482	0.488
SC Collaboration → SC Innovation (path invariance relaxed)	1299.483	995	1.306	0.031	0.953	1	0.492	0.483
SC Learning → SC Innovation (path invariance relaxed)	1299.974	995	1.307	0.031	0.953	1	0.001	0.975
SC Innovation → SC Performance (path invariance relaxed)	1299.960	995	1.306	0.031	0.953	1	0.015	0.903
Awareness → SC Innovation (path invariance relaxed)	1299.949	995	1.306	0.031	0.953	1	0.026	0.872

As concluded from the multi-group analyses above, both the measurement model and structural model were invariant across the two groups of rice and coffee. Therefore, the two separated samples of rice and coffee could be aggregated for hypothesis testing in the next step.

6.5.2 Assessment of the structural model in pool sample

As concluded in Section 6.4, all measurement scales of the investigated constructs are satisfactory after some refinements. In addition, the two groups of rice and coffee samples were validly pooled together for further analysis, as this is a pr-requisite to proceeding with the structural model and hypothesis testing in a pool data sample.

AMOS software was used to estimate the theoretical model based on the covariances matrix of the 33 variables. The Maximum Likelihood (ML) estimation method assumes that the variables are normally distributed. This assumption has been shown to be met by the data. All 33 variables have skewness values ranging from -0.805 to +0.653, and kurtosis values ranging from -0.821 to +0.468 (Table 6.20). The variables are normally distributed because all the values are less than 3.0 for skewness and 10.0 for kurtosis (Kline, 2015). Another criterion that ML requires is a large sample size and this has also been met in this model estimation because HOELTER index is 216 (Table 6.21), higher than the threshold of 200 (Byrne, 2010). These clearly indicated a normal distribution of the data and satisfied the sample size requirement of this study.

Table 6.21: Univariate normality of the composite variables

Variable	min	max	skew	kurtosis
TRU1_12	1	7	-0.468	-0.614
TRU2_13	2	7	-0.520	-0.617
TRU3_14	1	7	-0.461	-0.331
TRU4_15	2	7	-0.429	-0.540
CON1_16	1	7	0.039	-0.698
CON2_17	1	7	-0.046	-0.626
CON3_18	1	7	0.079	-0.708
COL1_19	3	7	-0.144	-0.203
COL2_20	3	7	-0.377	-0.297
COL3_21	3	7	-0.359	-0.417
COL4_22	3	7	-0.336	-0.197
COL5_23	1	7	-0.633	0.468
LEA1_24	1	7	-0.101	-0.821
LEA2_25	1	7	-0.363	-0.567
LEA3_26	1	7	-0.164	-0.318
LEA4_27	1	7	-0.212	-0.477
LEA5_28	1	7	-0.259	-0.681
AWA1_29	1	7	0.528	0.168
AWA2_30	1	7	0.577	0.394
AWA3_31	1	7	0.653	0.366
INN1_32	1	7	-0.291	-0.267
INN2_33	1	7	-0.653	-0.028
INN3_34	1	7	-0.504	-0.697
INN4_35	1	7	-0.414	-0.554
INN5_36	1	7	-0.777	0.212
INN6_37	1	7	-0.599	-0.204

INN7_38	1	7	-0.805	0.187
INN8_39	1	7	-0.209	-0.705
PER1_41	1	7	-0.284	-0.527
PER2_42	1	7	-0.458	-0.540
PER3_43	1	7	-0.514	-0.314
PER4_44	1	7	-0.284	-0.725
PER5_45	1	7	-0.301	-0.584

The statistical estimates of the model are shown in Table 6.22. It is obvious that all indexes indicated a satisfactory level of the overall fit of the model. Figures 6.5 and 6.6 show the structural equation model results, including the regression coefficients for the hypothesised paths between the constructs in the model.

Table 6.22: Fit indexes for the theoretical model

Fit Indexes	Estimates	Critical Value
Chi-square/dF	1.629	< 3
TLI	0.948	≥ 0.90
CFI	0.953	≥ 0.90
RMSEA	0.045	≤ 0.08
HOELTER	216	≥ 200

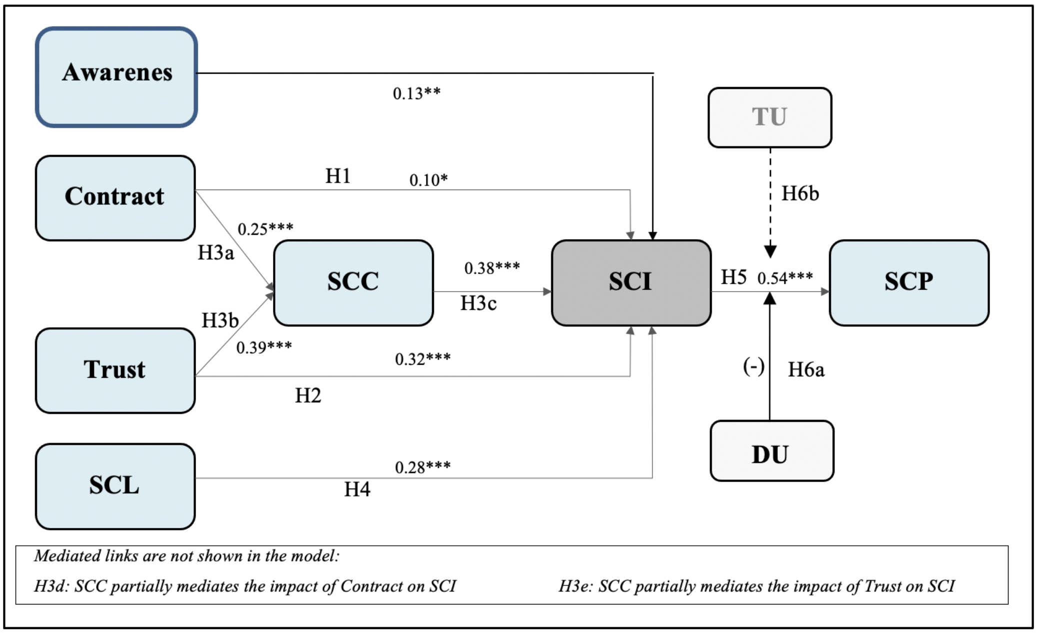

Figure 6.5: Structural equation model results

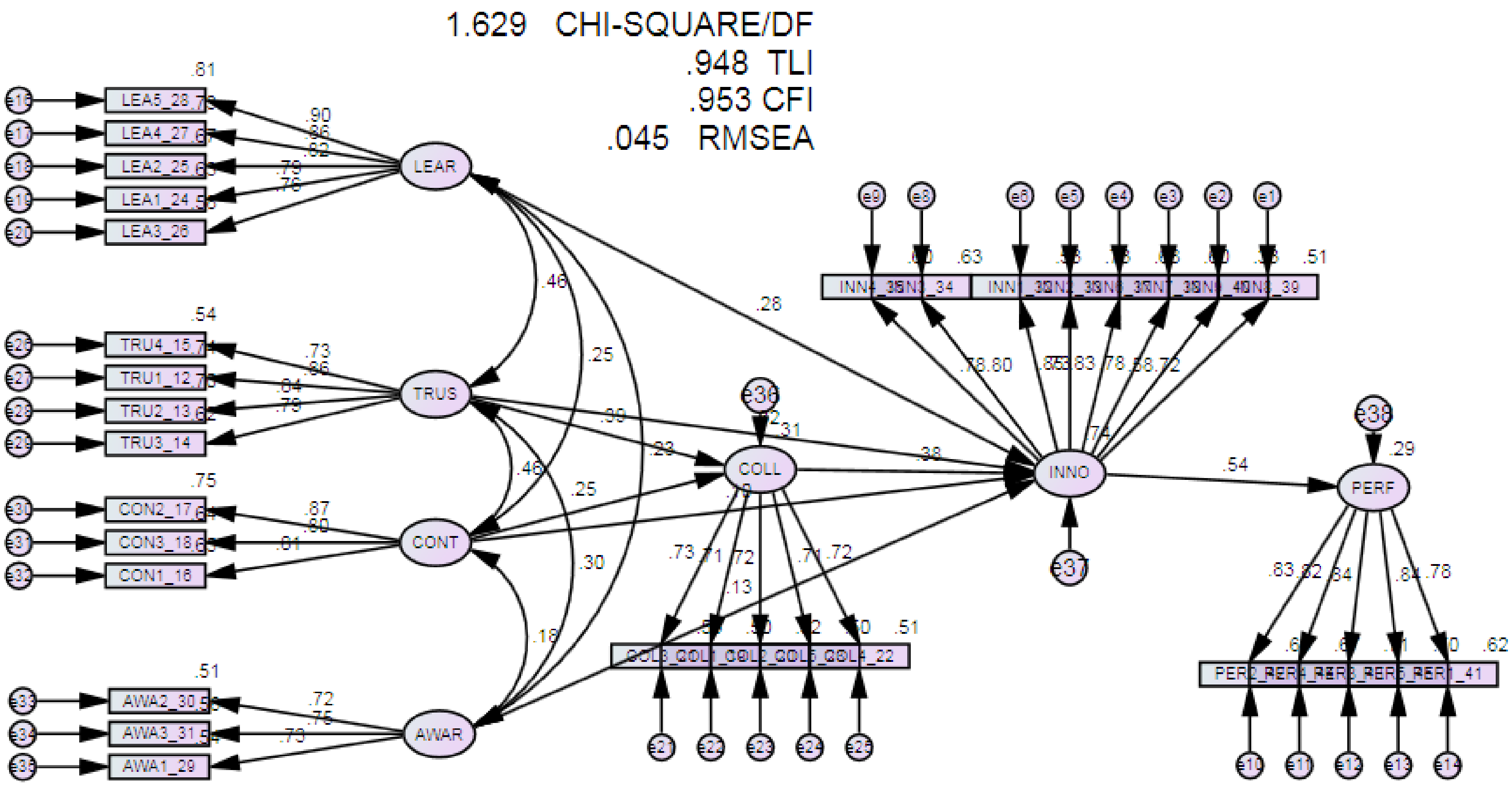

Figure 6.6: Structural equation model results in AMOS

6.5.3 Hypotheses testing in pool sample

In this section, the standardised regression coefficients obtained from the structural model are used to test the research hypotheses given in Chapter 3. The results for the hypothesised relationships in the model that include direct, indirect (mediation) and moderating impacts are presented in the subsequent sections.

6.5.3.1 Direct impacts

Table 6.23 summarises the SEM results of the direct hypothesised relationships and the impacts of the control variables.

Table 6.23: Structural Equation Modelling Results

Construct (pool sample)	Path coefficient	Supported/ rejected
H1: Contract → SC Innovation	0.10^{*}	Supported
H2: Trust → SC Innovation	0.32^{***}	Supported
H3a: Contract → SC Collaboration	0.25^{***}	Supported
H3b: Trust → SC Collaboration	0.39^{***}	Supported
H3c: SC Collaboration → SC Innovation	0.38^{***}	Supported
H4: SC Learning → SC Innovation	0.28^{***}	Supported
H5: SC Innovation → SC Performance	0.54^{***}	Supported
H7: Awareness → SC Innovation	0.13^{**}	Supported
Control variables		
Firm size → SC Innovation	0.02	Not Supported
Firm age → SC Innovation	-0.01	Not Supported
Firm size → SC Performance	-0.04	Not Supported
Firm age → SC Performance	-0.04	Not Supported

Note: * Significant level: $p < 0.05$; ** Significant level: $p < 0.01$;
*** Significant level: $p < 0.001$.

As shown in Table 6.23, the hypotheses H1, H2, H3d, H4 and H7 were supported, indicating the important direct impacts of Contract, Trust, SCC, SCL and Awareness, in that order, on SCI. The path coefficients for these relationships ranging from 0.13 to 0.39 suggest the respective rankings of each of these factors in terms of their importance to SCI. In particular, SCC and Trust were ranked the most important factors, while Contract and Awareness were the least important factors, with the lowest path coefficients and significant levels. The positive relationships between Contract, Trust and SCC (H3a, H3b) were also supported. Lastly, the supported hypothesis H5 level

(β = 0.54, p = 0.000) confirmed the significant influence of SCI on SCP.

However, in this study, major firm attributes including size and age were included in the SEM as control variables to test their possible impacts on SCI and SCP. The results show that all the path coefficients for the control variables on SCI and SCP are statistically insignificant. This implies that these relationships are not supported by the empirical data. In other words, firm size and firm age have no influence on either SCI or SCP.

6.5.3.2 Mediating impacts -Bootstrapping analysis

To test hypotheses H3d and H3e regarding the mediating role of SCC in the effects of Contract and Trust on SCI, bootstrapping analysis was conducted. Bootstrapping uses random sampling with replacement (resampling method) to resample a single dataset to create many stimulated samples and estimate indirect effects in each resampled data set (Hayes, 2017; Preacher & Hayes, 2004). This process enables the calculation of standard errors and construct confidence intervals around the indirect effects (Haukoos & Lewis, 2005; Hayes, 2017). The technique is recommended to test indirect effects as it does assume that the indirect effects are normally distributed and provide robust assessment of statistical significance with more accurate results compared to other techniques such as Sobel tets (Efron & Tibshirani, 1994; Hayes, 2009). Therefore, bootstrapping was conducted to test the mediating effects in the structural model. Specifically, this study used a bias-corrected bootstrapping approach that generated 5000 re-samples to empirically estimate the indirect effects and their significance. In order to understand the presence of a mediation factor, it is necessary to estimate the direct and indirect effects between independent and dependent variables (Zhao et al., 2010). The results of the bootstrapping analysis are presented in Table 6.24. As shown in the table, the indirect effects of Contract and Trust on SCI through SCC are significant (both at p-value < 0.01). Meanwhile, the direct effects of Contract and Trust on SCI are also significant, thus suggesting partial mediation effects of SCC in the relationships between both Trust and Contract and SCI (Zhao et al., 2010). This supports the hypotheses H3d and H3e.

Table 6.24: Bootstrapping results for mediation relationship tests (H3d and H3e).

Hypothesis	IV	MV	DV	Direct effect	Indirect effect	Result
H3d	CONT	COLL	INNO	0.10^{*}	0.09^{***}	Partial mediation
H3e	TRUS	COLL	INNO	0.32^{***}	0.15^{***}	Partial mediation

IV: Independent variable, MV: Mediating variable, DV: Dependent variable; CONT: Contract, TRUS: Trust, COLL: SC Collaboration, INNO: SC Innovation.
Note: Standardized effects, *** = p-value < 0.01, * = p-value < 0.05.

6.5.3.3 Moderating impacts – Multi-group analysis

As mentioned earlier in Section 6.5.1, multi-group analysis is commonly used to test whether models or varibales are variant across different groups (Hair et al., 2010; MacKinnon, 2011). Thus, the technique was used to test the moderating effects on the structural model, in particular testing measurement invariance and comparing the effect of every structural path across groups: High demand uncertainties versus low demand uncertainties, and high technological uncertainty versus low technological uncertainty. The procedures and results of Multi-group analysis for hypotheses H6a and H6b are as follows.

Hypothesis 6a: *The moderating role of Demand uncertainties on the relationship between SCI and SCP*

To perform the multi-group analysis for the moderating role of Demand uncertainties, the sample was split into two groups: low demand uncertainties (Group A) and high demand uncertainties (Group B). The sample splitting was performed based on the calculation of a mean value of the responses regarding the demand uncertainties. Once the mean value was calculated (mean = 3.46), the responses under the mean were classified as Group A (n=149), and the responses equal or above the mean value were categorised as Group B (n=169). SEM was conducted to compare the groups in order to discover whether demand uncertainties moderate the relationships between the constructs. First, the study tested the invariance of the measurement model in relation to the two different demand uncertainties groups. Table 6.25 shows the results of the measurement invariance tests based on the above procedure. Chi-square difference was used to check for statistical significance. When the unconstrained model was compared with the constrained model; the chi-square difference was 38.584 with 26 degrees of freedom and a p-value of 0.054, which is not statistically significant. Thus, the two models exhibit full metric invariance. This means that the measurement model is invariant from the two different groups of demand uncertainties.

Next, the same procedure was applied to test the invariance of the structural model in relation to the two groups of demand uncertainties. The constraint model was estimated by constraining all construct paths to be equal in both groups. The fit indices are presented in Table 6.25. Both models indicated an acceptable model fit. The chi-square difference was 58.739 with 34 degrees of freedom, which was statistically significant, with a p-value of 0.005. This confirmed that the structural model is variant from the two different demand uncertainty groups. Therefore, demand uncertainties moderate the relationships in the structural model.

Table 6.25: Multiple Group Invariance Analysis across Low and High Demand Uncertainty Groups

Model tested	χ^2	*df*	χ^2/df	RMSEA	CFI	Δdf	$\Delta\chi^2$	*p*
Testing for Measurement Invariance								
Unconstrained model	1249.727	948	1.318	0.032	0.956			
Constrained model (Measurement weights)	1288.275	974	1.323	0.032	0.954	26	38.584	0.054
Testing for Structural Equivalence								
Unconstrained model	1326.751	962	1.379	0.035	0.939			
Constrained model (Equality of path estimates)	1385.490	996	1.391	0.035	0.940	34	58.739	0.005

This study also employed the procedure introduced by Doll et al. (1998) for testing multi-group invariance. This step involved testing the invariance between the two-group model under different constraint condition: (1) model with equality constraints imposed for all path coefficients in the model, (2) model with relaxed constraint for the path coefficient of SCI → SCP and constraints imposed for the remaining paths. The results in Table 6.26 show that the path coefficient of SCI → SCP was statistically significant across the demand uncertainty groups at the 0.01 level. This indicates that the path coefficient SCI → SCP is different from the two different demand uncertainty groups. In other words, demand uncertainty moderates the impact of SCI on SCP. From Table 6.27, it can be concluded that demand uncertainty has a negative moderating effect on the relationship between SCI and SCP. In a low demand uncertainty environment, SCI affects SCP more strongly than it does in a high demand uncertainty environment.

Table 6.26: Testing for Invariance Across Low and High Demand Uncertainty Groups in the Structural Model

Model tested	χ^2	df	χ^2/df	RMSEA	CFI	Δdf	$\Delta\chi^2$	*p*
Constrained model (all invariance)	1385.490	996	1.391	0.035	0.940			
SCI → SCP (path invariance relaxed)	1370.028	995	1.377	0.035	0.943	1	15.462	0.000

Table 6.27: Path Estimates for Constrained and Unconstrained Models

Path	Unconstrained estimates (Group A)	*p* (Group A)	Unconstrained estimates (Group B)	*p* (Group B)
SCI → SCP	0.886	***	0.392	***

Note: Group A – Low uncertainty; Group B – High uncertainty; *** Represents significant at 0.001 level.

Hypothesis 6b: *The moderating role of technology uncertainties on the relationship between SCI and SCP*

The same procedure applied to test Hypothesis 6a was carried out to test Hypothesis 6b. Similarly, based on the mean value calculated (mean = 4.69), the sample was split into two groups: low technology uncertainty (n = 162) and high technology uncertainty (156). Table 6.28 presents the results of the measurement model invariance tests and structural model invariance tests for differences resulting from technology uncertainties. For the measurement invariance tests, the unconstrained model was compared with the constrained model; the chi-square difference was 19.224 with 26 degrees of freedom and a p-value of 0.827, which is not statistically significant. Thus, the two models exhibit full metric invariance, which means that the measurement model is invariant for respondents from different technology uncertainty groups. For the structural model invariance test, the chi-square difference was 21.834 with 34 degrees of freedom, which is statistically significant, with a p-value of 0.947. Thus, the structural model is invariant from the two different technology uncertainty groups, or technology uncertainty does not moderate the relationship in the structural model.

In relation to relaxing equality constraint for path coefficient SCI → SCP, the results in Table 6.29 report that the path coefficient of SCI → SCP was not statistically significant across the technology uncertainty groups at the 0.05 level (p-value = 0.760 > 0.05). Therefore, the hypothesis that technology uncertainty moderates the impact of SCI on

SCP is not supported.

Table 6.28: Multiple Group Invariance Analysis across Low and High Technology Uncertainty Groups

Model tested	χ^2	*df*	χ^2/df	RMSEA	CFI	Δdf	$\Delta\chi^2$	*p*
Testing for Measurement Invariance								
Unconstrained model	1309.194	948	1.381	0.035	0.946			
Constrained model (Measurement weights)	1328.418	974	1.364	0.034	0.947	26	19.224	0.827
Testing for Structural Equivalence								
Unconstrained model	1385.419	962	1.440	0.037	0.935			
Constrained model (Equality of path estimates)	1407.253	996	1.413	0.036	0.936	34	21.834	0.947

Table 6.29: Testing for Invariance Across Low and High Technology Uncertainty Groups in the Structural Model

Model tested	χ^2	*df*	χ^2/df	RMSEA	CFI	Δdf	$\Delta\chi^2$	*p*
Constrained model (all invariance)	1407.253	996	1.413	0.036	0.937			
SCI → SCP (path invariance relaxed)	1407.160	995	1.414	0.036	0.937	1	15.462	0.760

To this end, Figure 6.7 depicts an integrated framework of the process, analytical approaches used and key results of the structural model and hypotheses testing in this study.

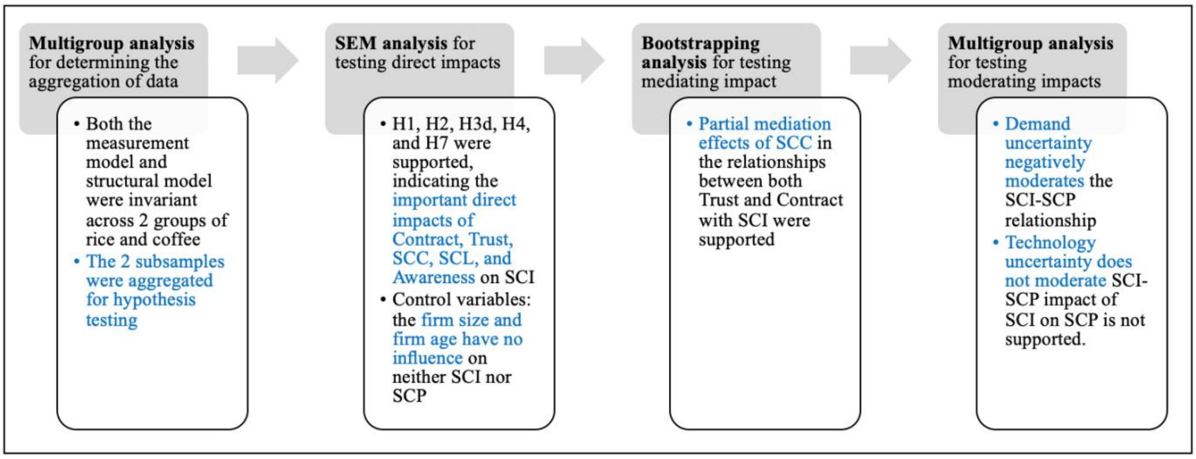

Figure 6.7: Summary of the process, approaches and key results of the structural model testing

6.6 Summary

Chapter 6 reports the statistical results of quantitative data for hypothesis testing. The assessment of the measurement model through EFA and CFA confirmed the reliability, uni-dimensionality and validity of measurement scales. Following these assessments, two inappropriate items (PER6-46 and INN9_40) were deleted and the refined measurements were then fitted into the structural model testing. The SEM results indicated that all the direct hypothesised relationships (H1, H2, H3a, H3b, H3d, H4, H5, H6, H7) in the structural model were supported in the pool sample. However, neither of the control variables, firm size and firm age, has an impact on either SCI or SCP. Bootstrapping analysis results indicated a partial mediating effect of SCC on the relationship between Contract, Trust and SCI (H3d, H3e). Lastly, multigroup analysis results supported the negative moderating role of Demand uncertainties for the SCI-SCP link but rejected that role in relation to Technological uncertainties. These statistical results will be interpreted and discussed in Chapter 7.

Chapter 7: DISCUSSION & CONCLUSION

7.1 Introduction

In this chapter, qualitative and quantitative results are integrated in order to interpret and discuss the findings in response to the research questions specified at the beginning of this study. While the quantitative results comprehensively answer the research questions in terms of confirming the casual relationships in the conceptual model, the qualitative findings provide in-depth and illustrative elucidation of the research problem, helping to provide insights into how and why the antecedents affect SCI, in turn improving SCP. This chapter first presents the assessment of the empirical appropriateness of the measurement model of this study (Section 7.2). This is followed by the interpretation and discussion of the research findings for each of the hypothesised relationships in the conceptual model (Section 7.3). Section 7.4 then highlights the contributions of this study. In Section 7.5, limitations of the study and directions for future research are presented. Lastly, Section 7.6 provides a brief conclusion of this study. Figure 7.1 depicts the outline of this chapter.

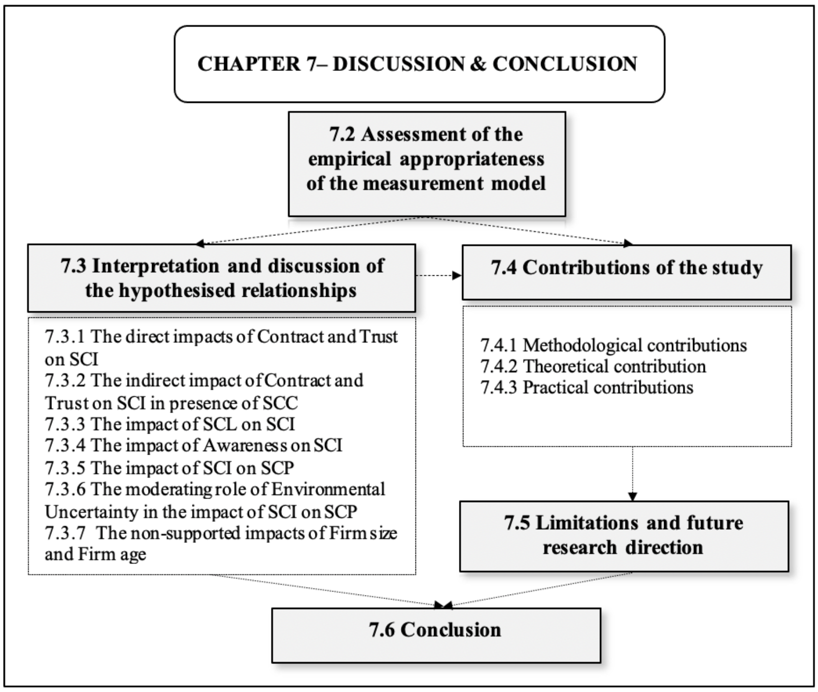

Figure 7.1: The outline of Chapter 7

7.2 Assessment of the empirical appropriateness of the measurement model

The qualitative findings in phase 1 of this study gave preliminary validation of the survey instruments. Indeed, evidence supporting the components of the measurement model was generated across the four case studies, as perceived by most of the interviewees. Prior to testing of the research hypotheses in phase 2, a rigorous approach comprising multiple statistical methods and techniques was employed to further assess and validate the measurement model. Initially, participant bias and common method variance assessment, which are considered common issues in survey-based research (Lambert & Harrington, 1990; Podsakoff et al., 2003), were performed to assess the extent to which they affected the research findings. The related results indicated no significant difference between the two periods of data collection and a non-significant common method variance. It could be therefore concluded that neither participant bias nor was a major issue for this study. Subsequently, a two-stage approach, EFA followed by CFA, was employed to confirm the reliability, uni-dimensionality and validity of the measurement scales (Hair et al., 2010). The approach has been successfully used in many previous studies in the field (e.g., Agarwal & Selen, 2013; Jajja, 2017; Seman et al., 2019). After the EFA, two inappropriate items (PER6-46 and INN9_40) were deleted, and the refined scales were then further assessed by the CFA. The CFA results required no further refinement of the scales to fit into the hypothesised structure. This revealed not only the high reliability and validity of the measurement model, but also the appropriateness of the surveyed data of this study. Possible reasons supporting this conclusion are: (1) the measurements in this study were adapted from previous empirical studies; (2) the measurements were also then supported and refined based on the case study data; (3) the survey data was collected through face-to-face interviews conducted by the researcher, helping to ensure the highest-quality and most accurate responses (Hair et al., 2000). Collectively, given the empirical appropriateness of the measurement model, this study proceeded to test the research hypotheses in the pool sample. The results of each hypothesis testing are interpreted and discussed in depth in the following section.

7.3 Interpretation and discussion of the hypothesised relationships

The results of the hypothesis testing and case study analysis in relation to the research questions specified at the beginning of this study are summarised in Table 7.1. In this section, the findings of each of the hypothesised relationships are interpreted and discussed using the integration of qualitative and quantitative findings. Where possible, verification and reconciliation of the inconsistencies suggested by previous research are also highlighted in light of this study‘s findings. Overall, most of the hypothesised relationships in the research model received strong support from both qualitative and quantitative findings, as discussed next.

Table 7.1: Summary of hypotheses testing in relation to the RQs

Research question (RQ) addressed	Hypothesis	Quantitative Results
RQ 1: How does Contract and Trust (Control mechanism) individually affect SCI?	**H1**: Contract is positively associated with SCI	*Supported*
	H2: Trust is positively associated with SCI	*Supported*
RQ 2: How does SCC affect SCI. Does it mediate the impacts of Contract and Trust on SCI?	**H3a**: Contract is positively associated with SCC	*Supported*
	H3b: Trust is positively associated with SCC	*Supported*
	H3c: SCC is positively associated with SCI	*Supported*
	H3d: SCC mediates the impact of Contract on SCI	*Partially mediated*
	H3e: SCC mediates the impact of Trust on SCI	*Partially mediated*
RQ 3: How does SCL affect SCI?	**H4**: SCL is positively associated with SCI	*Supported*
RQ 4: How does SCI impact SCP?	**H5**: SCI is positively associated with SCP	*Supported*
RQ 5: How do environmental uncertainties moderate the relationship between SCI and SCP?	**H6a**: Demand uncertainties negatively moderate the impact of SCI on SCP	*Supported*
	H6b: Technology uncertainties negatively moderate the impact of SCI on SCP	*Not supported*
RQ 6: How does Awareness affect SCI? *(developed based on the case study findings)*	**H7** Awareness is positively associated with SCI	*Supported*

7.3.1 The direct impacts of Contract and Trust on SCI

As revealed in the quantitative analysis, Hypotheses H1 and H2 – relating to the direct impacts on SCI of the control mechanism, represented by Contract and Trust –were supported. This confirms the importance of both Contract and Trust in promoting SCI.

This study also underscores that both Contract and Trust help to control opportunism and increase openness in supply chain relationships, which provide incentives and assurance for collaborative innovations in the supply chain. The interpretations of the H1 and H2 findings are as follows.

7.3.1.1 Contract and SCI

Both the qualitative and quantitative findings of this study indicate that Contract plays a vital role in SCI. These findings are in line with previous studies by Wang (2011), Bouncken (2011), Wang and Shin (2015) and Sumo et al. (2016). In a contractual relationship characterised by minimised opportunism and lower transaction costs, supply chain partners have more incentives for co-value creation, such as co-adopting innovative practices (Cao & Lumineau, 2015; Li et al., 2010), which in turn promote innovations in the supply chain. Contract also facilitates complementary resources and relationship-specific investments (Wacker et al., 2016) that enable the concentration and coordination of resources for innovative activities. As evident from the case study (Rice SC 2) findings, contract farming allowed the farmer to receive support from the companies in terms of input resources, investment in farming facilities and equipment, application of technologies in agriculture, training, and market development that enabled all partners to improve their innovation capabilities. The case study results also revealed that Contract with a high level of term specificity of innovative practices is necessary for companies to control and assess the behaviours of their sourcing farms, thereby ensuring the innovative practices to be performed appropriately and efficiently. In addition, Contract can also be used as an effective tool to manage possible conflicts (e.g., caused by the unstable market price of coffee) that can arise during co-innovations between the companies and the farms (Coffee SC 2).

This study findings can also be used to reconcile the inconsistencies thrown up by previous studies. Specifically, Wang (2011) and Sumo et al. (2016) suggested that overly detailed contracts or contracts with high term specificity may hinder innovations. In opposition to these arguments, Bouncken (2011) found that upstream directives (part of contracts), which provide specifications on the design, technical and functional issues of the innovation components, as well as guidelines and defined objectives of innovation, can increase innovations. This study‘s findings therefore reinforce the role of detailed contracts in innovations. In particular, it was found that contracts that carefully specify technical requirements for innovative practices (e.g., the use of input materials, sowing, irrigation and harvesting in the sustainable productions of rice/coffee) facilitate the enforcement of required procedures and guidelines as well as the effectiveness of the innovative practices. This is all the more understandable when farmers‘ low education levels and limited knowledge of innovative practices are taken into account. It is observed that research context plays an important role in contract-innovation linkage. For example, while high term specificity of contract was not suggested in service (Sumo et al., 2016) or manufacturing (Wang, 2011), it was critical for IT (Bouncken, 2011) and agriculture (as revealed by the qualitative findings of this study).

7.3.1.2 Trust and SCI

The findings from testing Hypothesis H2 suggest that Trust is an important determinant of SCI. A trust-based relationship encourages partners to share the reliable information and tacit knowledge required for joint innovative activities such as co-developing new products or assisting each other to improve operational processes (Paulraj et al., 2008; Poppo & Zenger, 2002). This in turn increases the innovation capabilities of firms and promotes innovations in the supply chain. Empirical evidence supporting the impacts of Trust on SCI was also found in the qualitative findings of this study. As perceived by the interviewees, agricultural business relationships should be based on mutual trust between the partners, since it is very difficult, if not impossible, to monitor the execution of contracts (farming production) regularly and continuously. Thus, Trust becomes a key control mechanism to maintain cooperation in innovative projects. In addition, Trust provides farmers with incentives and the confidence to participate in agricultural cooperatives and shift from their conventional farming practices to innovative and sustainable production. Companies with high levels of trust in their sourcing farms are also more likely to share know-how and invest in the technology transfers that are essential for innovations in agricultural supply chains. Such evidence was observed across the four cases. Generally, the findings on the relationship between Trust and SCI are strongly supported in the current literature (e.g., Iddris et al., 2016; Panayides & Lun, 2009; Song et al., 2010; Wang, 2011; Yeniyurt et al., 2014).

This study provides additional support for the conclusion by Wang (2011) that Trust, compared to Contract, is a more statistically powerful factor for promoting innovations.

The context of Vietnamese agriculture can assist in a better understanding of the more important role of Trust. Since Vietnam's legal system is relatively weak, the enforcement of contract is sometimes ineffective or even absent. The case study of Rice company 2 can be used to demonstrate this argument. The company has experienced rare situations where their contracting farmers sometimes deliberately broke contracts and supplied rice grain to another buyer who offered a higher price. the company had to accept this risk in order to avoid further complications or the cumbersome procedures of a lawsuit. In this case, the signed contracts are apparently void. Relying on trusted partners may at least help to prevent this kind of risk. Furthermore, the case study findings suggest that when Contract and Trust are used together, the perceived benefits will be greater (Rice SC 2 and Coffee SC 1).

The results of this study also challenge the assumption by Michalski et al. (2014) that a high level of trust does not result in an increase in IT innovations in emerging markets. In addition, this study provides qualitative and quantitative evidence classifying Trust as instrumental in technological innovations such as implementation technologies, e.g., satellite remote sensing or ERP systems in the supply chain, as observed by Rice SC 1 and Coffee SC 2.

In sum, although past studies investigated the impacts of Contract and Trust on innovation, most work linked these constructs to different dimensions or perspectives of innovation such as incremental and radical innovations (Bouncken, 2011; Sumo et al., 2016), investment in innovation (Wang & Shin, 2015), firm innovativeness (Panayides & Lun, 2009; Song et al., 2010), product innovation (Yeniyurt et al., 2014), or IT innovation (Michalski et al., 2014). These reveal the varied conceptualisations of innovation that emerge from investigations of the link between the Control mechanism and SCI in the current literature. In addition, little work has been undertaken to examine relationships in the context of supply chain relationships. This study supplements previous studies by exploring the impacts of these constructs on SCI that cover the three most common types of innovation –product, process and technological innovations –in the context of a connected supply chain that involves different functions in the chain to hit the call?? by Gao et al. (2017). Furthermore, the research context of this study, undertaken in an agricultural supply chain in a developing country characterised by a fragmented supply network and the presence of many intermediaries, helps to enrich understanding of the impacts of Control mechanism on SCI.

7.3.2 The indirect impact of Contract and Trust on SCI in presence of SCC

The quantitative results suggest a partial mediation of SCC in the effects of both Contract and Trust on SCI (H3d, H3e), in which H3a and H3b relate to the impacts of Contract and Trust on SCC, respectively, and H3c relates to the relationship between SCC and SCI, where all are supported. This means that Contract and Trust both positively affect SCC, which in turn promotes SCI. The mediating role of SCC is discussed with respect to each of its component hypothesised relationships next.

7.3.2.1 SCC and SCI

A high positive association between SCC and SCI revealed in SEM analysis suggests that SCC has a significant impact on SCI. This factor is ranked the most important antecedent to SCI, compared to other factors such as Contract, Trust and Learning. The importance of SCC as a means of facilitating joint planning, information and resource sharing, risk and benefit sharing, joint decision-making and frequent communication in SCI has been addressed in the literature (e.g., Haus-Reve et al., 2019; Iddris et al., 2016; Jajja et al., 2014; Li et al., 2018; Luzzini et al., 2015; Melander, 2018; Singhry, 2015; Soosay et al., 2008; Yunus, 2018). Collaboration with supply chain partners allows firms to extend their restricted resources and competencies, enabling them to exploit new knowledge and new market and technological opportunities that boost their innovative capabilities (Faems et al., 2005; Zahra et al., 2007). For instance, firms targeting to adopt green innovations usually seek collaborative relationships to secure access to green materials, knowledge and technology from their network (Dangelico et al., 2017). Furthermore, through collaborative relationships, firms are willing to share complementary resources and make relationship?-specific investments with their partners to achieve mutual goals of innovations (Gligor & Holcomb, 2012; Henke & Zhang, 2010). This significantly promotes innovations across the supply chain. It was also empirically validated by a recent study that found that SCC is a crucial aspect of innovations, especially in agricultural supply chains which involve various stakeholders and many intermediaries in the supply chain (Krishnan et al., 2020).

The way SCC contributes to SCI can be best illustrated by the Rice supply chain 1 case study, which is characterised by strong collaboration between the supply chain members, in particular the focal company, the Rice cooperative and their participating farms. In this integrated supply chain, participating farms receive a great deal of support from both the cooperatives and the companies, including input materials, farm equipment and technologies. This allows them to extend their limited resources and technology capabilities to improve/reform their farming practices, such as automating farming processes and applying advanced technologies in farming processes. The cooperative and the company‘s agricultural engineers/technicians work very closely with the farmers to provide them with timely advice on best farming practices. In addition, information and knowledge about, e.g., new seed varieties, farming techniques and technologies are usually updated and shared across the supply chain through daily communications and regular meetings and training sessions. Such collaborative activities enabled the sustainable rice project to be implemented successfully within the supply chain.

The empirical results of this study corroborate prior work by Jajja et al. (2014) by offering further empirical evidence for the significant impacts of Collaboration on SCI in emerging markets such as Pakistan, where cultural norms may affect collaboration in supply chains. This study also supplements insights about the necessity for Collaboration for SCI in the context of horticultural supply chains in developing countries, such as India, characterised by a fragmented supply network and the presence of many intermediaries in the supply chain, as observed by Krishnan et al. (2020). The case study findings are also in line with those of Soosay et al. (2008), who cited SCC as an effective enabler of both incremental (e.g., improving soil fertility using bio-organic fertilisers, improving drying techniques, investing in more efficient threshing machines to reduce losses) and radical innovations (e.g. moving from conventional farming towards precision farming based on the sustainable production of rice and coffee and the application of satellite remote sensing technology in farming).

7.3.2.2 The impact of Contract and Trust on SCC

The hypothesised relationships regarding the impacts of Contract and Trust on SCC (H3a, H3b) were supported, suggesting that a stronger role for Contract and Trust contributes to Collaboration in supply chains. The findings are not novel and coincide with many existing studies such as Cachon (2003), Chong et al. (2009), Poppo and Zenger (2002), Sridharan and Simatupang (2013), and Myhr and Spekman (2005). Contract, known as a formal control mechanism, helps to manage conflicts and reduce uncertainties in an exchange relationship, thereby encouraging collaboration between supply chain partners (Poppo & Zenger, 2002). Trust, as an informal or relational control mechanism, motivates partners involved in information sharing, open communication and joint problem-solving to gain mutual benefits that stimulate collaboration in the supply chain (Fawcett et al., 2012; McEvily & Marcus, 2005; Morgan & Hunt, 1994).

In relation to the case study data, these findings provide justification for the incentives for farmers to join the cooperatives and/or sustainable projects of the companies. The farmers asserted that the use of contracts helped to prevent hostility in relationships and minimise conflicts, thus enabling smooth coordination between them and the companies. In addition, when they trust the cooperative and the companies, they are more likely to cooperate and rely on them.

7.3.2.3 Mediating role of SCC

The results of the bootstrapping analysis support the indirect effects of both Contract and Trust on SCI mediated by SCC (H3d, H3e). Meanwhile, the direct effects of Contract and Trust on SCI (H3a, H3b) were also significant. This suggests a partial mediating role of SCC in the Trust-SCI and Contract-SCI relationships. This finding emphasises the critical role of the control mechanism in promoting SCI in either a direct or indirect manner. Indirectly, the control mechanism facilitates collaborative activities by the supply chain partners (e.g., resource sharing, joint problem-solving, joint decision-making), which in turn promotes the realisation and implementation of innovations in the supply chain. This finding is consistent with that of Song et al. (2010) about the relationship between Trust and innovativeness mediated by joint problem-solving. It should be noted that the mediating role of SCC makes the importance of the control mechanism in SCI more transparent by providing an explanation of how the control mechanism influences innovations.

The case study findings can facilitate better understanding of the mediating role of SCC. For example, in a collaborative relationship, Coffee company 2 usually provides coffee farm 2 with financial support, input resources, training, equipment and technologies, etc. This happens because of their trust of the farmers and the existence of a contract between them, and leads to innovative farming practices being adopted in the supply chain.

Existing studies on SCC have often classified it as a determinant of SCI and examined its influence on SCI, while very few studies explore whether this factor acts as a mediating mechanism. Only one existing work, by Li et al. (2018), was found to test the mediating effect of SCC on the relationship between learning and service innovation performance. In addition, while many previous studies investigated the direct impacts of Contract and Trust on SCI, little evidence was found to demonstrate the indirect effects of these factors, with the exception of the work by Song et al. (2010). Thus, these study findings enrich the empirical research on these factors to a degree. In addition, although a number of prior studies investigated the relationship between collaboration and innovation, they were based on different dimensions of innovation, such as product innovation (Haus-Reve et al., 2019; Jajja et al., 2014; Melander, 2018), service innovation (Li et al., 2018), innovation performance (Luzzini et al., 2015; Macchion et al., 2017), innovation capability (Singhry, 2015), and radical and incremental innovation (Soosay et al., 2008; Yunus, 2018), all of which bear little relation to the conceptualisation of SCI in this study, as measured by a combination of multiple types of innovation.

7.3.3 The impact of SCL on SCI

The supported H4 verifies that SCL can foster SCI. Learning allows supply chain members to extend their restricted knowledge resources and exploit complementarities with their partners that enhance their innovations capabilities (Baffour Awuah & Amal, 2011; Hsueh et al., 2010). Learning assists firms to obtain key information, know-how and necessary capabilities, which are critical in innovation development (Bessant et al., 2012; Lisi et al., 2019). In addition, through learning, partners can gain access and exposure to diverse sources and perspectives of knowledge, enlightening them on novel ideas and approaches that can lead to innovations (Subramaniam & Youndt, 2005).

In line with the findings by previous studies (e.g., Agarwal & Selen, 2009, 2013; Flint, 2008; Iddris et al., 2016; Jean et al., 2018; Leal-Millán et al., 2016; Lisi et al., 2019; Mylan et al., 2015), the case study findings provide evidence supporting the positive impacts of learning on SCI. The cases of Rice supply chain 1 and Coffee supply chain 2 demonstrated that SCL helps to improve the innovation capabilities of supply chain members, thereby promoting innovations across the supply chain. Learning activities in the Rice supply chain 1 occur regularly through not only internal training and meetings, but also conferences and seminars, where ideas are solicited from many stakeholders, such as input suppliers, farmers, companies, cooperatives, researchers and local authorities. These opportunities enable the supply chain members to explore and obtain information and knowledge about, e.g., market trends, customer preferences and technological opportunities, as well as best farming practices in the industry. This new knowledge, acquired from stakeholders within and outside the supply chain, supplemented their own knowledge and capabilities, and then was integrated and applied to improve their farming processes or adopt new practices. Specifically, the focal company in this supply chain explained that its learning involves listening to participating farmers (e.g., on the choice of input materials, efficiency of the improved processes or any difficulties caused by new farming techniques/technologies) and their buying customers (e.g., feedback about product quality, conformance to standards or changes in customer preferences), as well as their agricultural engineers, who work closely with farmers (e.g., giving technical advice and know-how about sustainable rice production). The feedback and advice received from these partners were then incorporated to adapt the company/s business operations and innovation strategies. In sum, the learning has enabled them to implement innovative practices and ensure positive outcomes, according to the manager of Rice company 1. Coffee supply chain 2 experienced a similar situation that revealed the significant impacts of learning on innovation in the supply chain.

While a number of past studies explored the link between learning and innovation, most work focused on similar but different?? conceptualisations of learning, such as relationship learning (e.g., Jean et al., 2012; Leal-Millán et al., 2016), collaborative learning (e.g., Agarwal & Selen, 2011; Agarwal & Selen, 2013), joint learning (e.g., Jean et al., 2018) or interactive learning (e.g., Mylan et al., 2015). In addition, very little work has examined the relationship between learning and innovation in the context of a supply chain. Thus, this study corroborates Lisi et al. (2019) and supplements the literature on SCL through the triangulation of mixed qualitative and quantitative findings. In particular, this study validates and enriches the measure of SCL adapted from and developed by (Flint, 2008), which is considered the first and the most comprehensive measure of SCL.

7.3.4 The impact of Awareness on SCI

The proposed relationship between Awareness and SCI (H7) was supported by the quantitative results. The findings are also consistent with those of existing studies, which confirmed the important role of Awareness in different supply chain activities such as the adoption of traceability systems in the food supply chain (Mattevi & Jones, 2016), and the implementation of environmental supply chain cooperation practices (Zhu et al., 2017). Awareness allows supply chain members to recognise the benefits of innovation adoption (Mattevi & Jones, 2016), thereby motivating them to implement innovative practices in a responsible and reliable manner in order to achieve desired outcomes. For example, the farmer in Coffee supply chain 2, who has recognised the significance and value of the sustainable production of coffee, has responsibly employed different modern farming practices, such as drip irrigation and bio-organic fertilisation, as well as following the defined procedures and regulations of sustainable coffee production. The case of Rice SC 2 also provided evidence that lack of awareness has been a challenge and has caused difficulties during the implementation of innovations (See Section 5.5.6 in Chapter 5). This is in line with the conclusion by Hegnsholt et al. (2018), who identified lack of awareness as a root cause of food loss and waste across the supply chain.

It is observed that the link between Awareness and SCI has been unexplored in the previous literature. This study therefore is the first attempt to provide empirical evidence demonstrating the importance of Awareness in SCI. In addition, the study findings empirically validate the conceptualisation of Awareness developed by Mattevi and Jones (2016).

7.3.5 The impact of SCI on SCP

Hypothesis H6 regarding the relationship between SCI and SCP was supported, suggesting a positive influence of SCI on SCP. As revealed by the case study results, the implementation of innovative practices brought many benefits to the supply chain members, enhancing the performance of the entire supply chain in the shape of improved product quality, reduced production costs, improved delivery reliability, responsiveness and product conformance to specification, and increased customer satisfaction (see Section 5.5.4). The findings also find support in the extant literature which found that SCI has been widely accepted as a crucial instrument for improving firm and/or supply chain performance (e.g., El-Kassar & Singh, 2019; Kim & Chai, 2017; Nguyen & Harrison, 2019; Piening & Salge, 2015; Yoon et al., 2016).

Although the outcome of innovations has been well explored in the literature, limited work has been conducted in the supply chain context. Indeed, a large number of previous studies investigated the link between innovation and an individual firm‘s performance (e.g., Chinomona & Omoruyi, 2016; Grawe et al., 2009; Ho et al., 2018; Ju et al., 2016; Nguyen & Harrison, 2019; Piening & Salge, 2015). This study supplements these studies by empirically extending the scope of the innovation to a connected supply chain and examining its impacts on supply chain performance, as was investigated by previous researchers such as Kalyar et al. (2019), Panayides and Lun (2009), Seo et al. (2014), and Singhry (2015). However, in these prior works, supply chain performance was linked to different perspectives of innovation such as ‗innovativeness' and ‗innovation capability', and was assessed based a binary relationship such as supplier-buyer in the supply chain. Thus, this study is the first attempt to examine the impacts of a comprehensive SCI on an entire supply chain involving multiple actors acting in core functions in the chain. The case study findings also endeavour to answer how SCI results in a superior supply chain performance, using the mixed findings of qualitative and quantitative methods. For example, a process innovation such as drip irrigation or inter-cropping, helps to significantly reduce production costs by minimising the consumption of resources such as water (Coffee SC 2).

7.3.6 The moderating role of Environmental Uncertainty in the impact of SCI on SCP

The hypothesised H6a regarding the moderating role of demand uncertainty in the relationship between SCI and SCP was supported, while the hypothesised H6b about the moderating role of technology uncertainty in the relationship was not supported. The findings indicated that demand uncertainties negatively moderate the SCI-SCP relationship, while technology uncertainty has no moderating effect on the relationship.

Under a high level of demand uncertainties, the influences of SCI on SCP are less evident. Indeed, when operating in a high-demand uncertainty environment, it seems to be difficult, if not impossible, for firms to capture customer needs and preferences (Jaworski & Kohli, 1993). This affects firms‘ ability to align their innovation strategies and activities, such as new product development, with market demand or customer expectations. The prediction errors of demand can, in turn, reduce the influence of innovative practices on performance. The case of Coffee supply chain 2 can be used to demonstrate this argument. As observed by the supply chain members, the relatively unstable and unpredictable demand for coffee impelled the company to confront the challenge of defining appropriate innovation strategies and estimating the outcomes of innovative practices. This occurred in a practical way when the company invested in, developed and introduced a new brand of organic coffee, but found that demand for and sales of this innovative product were not as high as predicted, leading to low efficiency together with the high cost of investment in this product innovation. In this case, it is clear that demand uncertainty reduced the positive impacts of the product innovation on performance.

On the other hand, the findings of this study show that technological uncertainties have no moderating effect on the SCI-SCP link, although the technologies used in the rice and coffee industries were recognised as uncertain due to their rapid evolution, high investment cost and complexity (e.g., of drone spraying), as observed by the case study participants. A possible explanation for this may be related to the measure of SCI, which covers different types of innovation, such as product, process and technology innovation. The case study data revealed that many of the innovative activities adopted by the supply chain members were incremental, such as improved products/processes (e.g., using organic fertiliser, better seed selection, improving post harvest processes such as harvesting at the right time or no delay in drying after harvesting, multi-cropping or inter-cropping), which did not require a technology application or were not sensitive to the high cost and complexity of technologies in the industry. Thus, regardless of technology uncertainties, the influence of innovative practices on performance was not affected.

To the reseacher‘s knowledge, this study is the first to investigate the moderating effects of Environemental Uncertainties on the SCI-SCP linkage while prior studies were more likely to explore the moderating of Environmental uncertainties on the relationship between innovation and its antecedents such as Supply chain integration (G.-C. Wu, 2013) or Contract and Trust (Wang, 2011). This study also supplements past studies (e.g., Kalyar et al., 2019; Panayides & Lun, 2009; Seo et al., 2014) that examined the impacts of SCI on SCP by exploring the moderating role of ENU in the relationship to make novel theoretical contribution to TCT. Furthermore, the study's findings supplement previous research by Mandal (2016b) by separating environmental uncertainties into demand and technology uncertainties in order to understand the differentiated moderating effects of these two dimensions on the SCI-SCP link.

7.3.7 The non-supported impacts of firm size and firm age

Prior literature suggested that firm size and firm age are important variables of innovation and/or innovative performance (Jajja, 2017; Kabadurmus, 2020; Wang, 2011; G.-C. Wu, 2013). Large-sized firms may have more resources and capabilities to adopt innovations (e.g., slack resources and know-how) (Lin et al., 2009; Liu, Li, et al., 2009). Similarly, older firms may have better capabilities such as knowledge and stronger collaborators with their supply chain partners, as well as high ability to deal with uncertainties that may influence the adoption of innovation and performance (Coad et al., 2016; Spencer, 2003). These firm characteristics were therefore included as control variables in this study.

The survey data analysis result indicated that firm size was not related to innovation and its impacts on the performance. This finding is consistent to that of previous research (Jajja et al., 2017; Mandal, 2015; Wang, 2011; G.-C. Wu, 2013). The pattern of firm size is similar to that found for firm age. In line with the prior study by Kabadurmus (2020), the finding showed that firm age cannot determine the capability and adoption of innovations. However, these findings also assert the opposite of those produced by Balasubramanian and Lee (2008), Mazzarol et al. (2010), and Nguyen and Harrison (2019), who found that the impacts of firm size and/or firm age were significant.

The context of this study may help to further clarify the impacts of firm size/age on innovation. The survey was done with many small-sized farms/firms in agriculture, who usually implement incremental product and process innovations such as better selection of input materials and improving current farming processes. The restrictions on their resources and technological capabilities cannot limit their ability to innovate in terms of incremental product and process improvement. In addition, in the context of supply chain, small farms/firms may have closely cooperation with their upstream and downstream partners, thereby enabling them to get assistance and support on resources and technologies from the partners. They may be also involved in the innovation processes/practices employed by the partners that help enhance their innovation capability. This can be demonstrated by the findings of case study 1 and 4 where the Rice company 1 and Coffee company 2 involved their sourcing farms into their innovation strategies and provide them with great supports ranging from resources, knowledge to technologies to promote innovation and its outcomes across the supply chain. On the other hand, large firms with stronger financial resources are usually able to bear the losses/consequences that arise from unsuccessful innovations (Damanpour, 1992) and are more likely to consider government regulations that might increase their innovations (Mazzarol et al., 2010), as revealed by the case of Rice company 1. Thus, this study findings strengthened the argument that firm size cannot determine innovation adoption and performance and its impacts may vary according to the type of innovation involved (Kimberly & Evanisko, 1981). For instance, innovation within small firms may involve the improvement of existing products, the development of new process or new markets while innovations within large firms may relate to the adoption of new technologies or marketing methods. Similarly, both new firms (e.g., Coffee company 1B) and old ones (e.g., Coffee company 2) were found to implement different innovative practices (see Table 5.4 in Section 5.5.1) to improve their performance. In short, this study enriched the existing literature by providing evidence of the nonsignificant impacts of firm size and firm age, especially when taking into account the research context and the type of innovation examined.

7.4 Contributions of the study

Apart from the theoretical implications identified in each of the hypothesis testing results discussed earlier in Section 7.3, further implications and contributions of this study are discussed in this section. The findings of this study are significant in terms of two methodological, four theoretical and two practical contributions, as well as policy implications, all of which are discussed next.

7.4.1 Methodological contributions

From a methodological perspective, this study demonstrates the effectiveness of the mixed-methods research approach, based on a combination of case studies and a survey, which has been rarely used in this research area. While the survey method has been used predominantly in SCI research (Jajja et al., 2019), the survey findings mostly confirm causal relationships between SCI and its antecedents/consequences concerning whether the variables are positively/negatively correlated (Hair et al., 2010). Thus, this study has employed a mixed-methods design in which the combination of inductive and deductive enquiries provides a richer and deeper understanding of SCI, its antecedents and consequences. In particular, the case study findings add insights to the interpretation of the survey findings by providing in-depth understanding of how the hypothesised relationships work in the real-life context of the agricultural supply chain; for example, of how SCC affects SCI, instead of examining only the statistical correlation between SCC and SCI. In addition, the qualitative results enrich and preliminarily validate the theoretical model and the measurements, which formed a reliable basis for hypothesis testing in the quantitative phase.

Another methodological contribution of this study involves a rigorous quantitative research design characterised by a large sample survey. The study employed a two-stage approach, EFA followed by CFA, to carefully assess and ensure the reliability, uni-dimensionality and validity of the measurements using a number of analytical techniques. The refined and validated measurements were then used to test the research hypotheses based on a large sample of 318 actors operating in different core functions of the supply chain, from growing and processing to trading and exporting, etc. This enabled the study to meet the requirements of SCI research, which is expected to involve all stakeholders in the supply chain (Arlbjørn et al., 2011; Gao et al., 2017). Another strength of this study is the researcher‘s immersion in the data collection through in-depth interviews and direct observations before and/or after each interview in the qualitative phase, and face-to-face surveys of 318 participants in the quantitative phase. This helped to produce more accurate and insightful findings that can be generalised for other situations.

In short, the mixed-methods design that uses a combination of inductive and deductive logic has enabled this study to provide a more reliable measurement model and more robust findings than those of the many previous studies conducted based on a single method.

7.4.2 Theoretical contribution

This research makes four theoretical contributions, as follows.

Theoretical contribution 1: *The unified framework integrating dimensions, antecedents and consequences of SCI resulted from the systematic literature review*

Based on the systematic literature review conducted in Chapter 2, this study first contributes to the SCI literature by synthesising and structuring knowledge to provide a holistic understanding of SCI. The review offers a unified framework which integrates three meta-constructs –the dimensions, antecedents and consequences of SCI – and highlights the central themes in each of the constructs. The dimensions of SCI that emerge from the relevant literature are organised into degrees, types and scope of SCI. The critical antecedents of SCI are consolidated according to three different levels: organisational, inter-organisational and environmental. Finally, the consequences of SCI show the relationship between SCI and its impact on two levels; namely, firm and supply chain performance. This framework provides a base understanding of what has been examined in the literature and lays the foundation for future research to build on it or to reassess the existing body of work.

Theoretical contribution 2: *Extension and novel contribution to TCT and DCT*

Drawing on TCT and DCT, this study developed a conceptual framework to investigate the relationship between SCI and its important antecedents including Contract, Trust, SCC, SCL and Awareness, as well as examining the influences of SCI on SCP moderated by Environmental uncertainties. The empirical findings supporting these relationships have extended and made novel contributions to TCE and DCT as follows:

- The current literature has addressed the direct impacts of Control mechanism (Contract and Trust) on SCI (e.g., Panayides & Lun, 2009; Sumo et al., 2016; Wang, 2011), but has not explored the indirect impacts of these factors on SCI mediated by SCC. Similarly, the existing research on SCC has often considered it only as an antecedent variable, and failed to demonstrate whether collaboration can act as a mediating mechanism. Thus, by focusing on SCC as an important mediating construct in the relationship between Control mechanism and SCI, this study brings new insights into TCT and DCT. In addition, it provides empirical evidence supporting the role of contract in SCI, which has been less explored in the literature.

- Of the related past studies that tested similar but different conceptualisations of learning, such as relationship learning (e.g., Jean et al., 2012; Leal-Millán et al., 2016), collaborative learning (e.g., Agarwal & Selen, 2011; Agarwal & Selen, 2013), joint learning (e.g., Jean et al., 2018) and interactive learning (e.g., Mylan et al., 2015), very few examined the relationship between learning and innovation in the context of the supply chain. This study is therefore the first to examine the impact of SCL on SCI, simultaneously validating the conceptualisation of SCL which was originally developed by Flint (2008), and extending DCT accordingly.
- This study is in the vanguard of exploring the impacts of Awareness on SCI, which have been missing in the literature. Also, in line with the relevant literature and based on the qualitative findings, this study developed and empirically validated the measure for Awareness, which was previously unexplored in the literature. The findings on the Awareness-SCI link contribute novel value to the TCT.
- While previous studies were more likely to focus on the relationship between SCI and a firm‘s performance, the influence of SCI on SCP has rarely been examined. In addition, this study is the first to examine the SCI-SCP relationship under the moderating impact of ENU, thus making a novel theoretical contribution to TCT.
- Another contribution of this study is the verification and reconciliation of conflicting findings suggested by prior studies on SCI, as discussed in Section 7.3.

Theoretical contribution 3: *Contribution to a new strand of literature on SCI toward a complete SCI and a comprehensive measurement of SCI*

In the literature, SCI has been conceptualised in a rather fragmented way, based on different dimensions and perspectives of innovation such as incremental and radical innovations (Bouncken, 2011; Soosay et al., 2008; Sumo et al., 2016), innovativeness (Panayides & Lun, 2009; Song et al., 2010), innovation capability (Singhry, 2015), product innovation (Jajja et al., 2014; Yeniyurt et al., 2014), and technology innovation (Lee et al., 2014; Michalski et al., 2014). This indicates the varied and inconsistent conceptualisations of innovation in prior investigations of the antecedents and consequences of SCI. In addition, while many studies have characterised SCI as focusing on an individual firm (e.g., Gölgeci & Ponomarov, 2015; Jiménez-Zarco et al., 2011; Salunke et al., 2011) or on dyadic/binary relationships (e.g., Kim & Chai, 2017;

Panayides & Lun, 2009; Wang, 2011), very few studies have examined the relationships in the context of supply chain relationships.

Based on these observations, this study offers a unique contribution by developing a comprehensive measurement scale for SCI resulting from the adaptation of innovation items in previous research and underlining the three most common types of innovation: product, process and technological innovations. The measurement was then tested in the real-life context of a supply chain that involves multiple actors operating in different functions in the supply chain. In doing so, the study responds to the recent call from Gao et al. (2017) to demonstrate the effectiveness of their integrated definition of SCI through an empirical study. Moreover, this study provides a richer and more holistic understanding of SCI, as well as establishing a new, comprehensive and empirically validated measurement of SCI.

Theoretical contribution 4: *Enriching understanding of SCI through agricultural supply chain context in a developing country*

The contribution of this study also lies in the research context in which the theoretical model was tested: two agricultural supply chains in a developing country, Vietnam. The Vietnamese agricultural supply chain is characterised by a fragmented supply network and the presence of many intermediaries in the supply chain, as well as inefficient processes occurring at every stage of the supply chains (OECD, 2015; Pham et al., 2017; World Bank Group, 2016) that demonstrate the distinct effects of control mechanism, collaboration and learning on the innovations in an inefficient supply chain. While a mass of related literature focuses on the manufacturing and service contexts, very little research has been conducted in an agricultural context. Thus, testing the theoretical framework in an agricultural supply chain context enables this study to enrich understanding of SCI as well as adding new value to TCT and DCT.

7.4.3 Practical contributions

7.4.3.1 Managerial implications

In general, by establishing critical antecedents and consequences, this study‘s findings can help to stimulate SCI implementation and success, leading to an overall improved SCP. In particular, the findings will help managers to acknowledge the critical influential factors of SCI, thereby enabling them to undertake better management and effective decision-making in relation to their business operations and supply chain activities, as well as their innovative practices, which are instrumental in SCI. In addition, the findings will help identify the likely significant impacts of SCI on SCP, which will help managers to not only adopt but also develop SCI. Lastly, the findings will provide an understanding of the effects of ENU on the SCI-SCP link, facilitating the development of strategies to deal with ENU and maximise the effectiveness of SCI implementation. The contributions are especially critical for Vietnam's agricultural supply chains, which have a great need for successful and effective innovations to improve supply chain performance. Specifically, the study has many managerial implications, including:

- ❖ Related to Control mechanism and SCC

The qualitative and quantitative findings of this study both confirmed the significance of the Control mechanism, SCC, SCL and Awareness for SCI, which in turn improves SCP. From an empirical perspective, the most important determinants that promote innovations in the supply chain were identified as SCC and Trust. The role of these factors is all the more important in relation to the weaknesses of Vietnamese agricultural supply chains, which almost always involve fragmented production and many intermediaries in the chain. The findings suggest that companies should place emphasis on developing trust-based and collaborative relationships with their supply chain partners, especially with the farmers who are mainly responsible for the production and quality of the products.

Trust enables the partners to rely with more confidence on the company and co-adopt innovations. Although both trust and contract play important roles in governing supply chain relationships, it is observed that trust is more important in the early stages of the partnership. Indeed, the case study findings provide evidence that farmers initially make a decision to participate in cooperatives and implement new farming techniques based on their trust in the cooperative and the company (Rice SC 1). Thus, it is vital for managers to understand what gives rise to trust, such as building a good reputation, sharing reliable information and keeping promises, in order to enhance the development of trust in their partnerships with other supply chain members.

It is also suggested that managers should recognise key characteristics of collaboration, such as resource sharing, benefit and risk sharing, joint decision- making, or frequent communications, then take proactive actions to facilitate collaboration across the supply chain. For instance, managers should create convenient channels/means to ensure frequent communication with other supply chain partners by using smartphones, social media and/or regular online meetings (Rice company 1). Managers should place importance on resource sharing with upstream partners such as farmers, as this is especially necessary for farmers with limited resources and limited financial and technology capabilities for implementing innovations. Moreover, collaborative practices should take place not only within but also outside supply chains, especially with international institutions/organisations in order to leverage external support and investment. The case of Rice company 1 serves as an example. The company has partnered with the International Finance Corporation (IFC), which is a member of the World Bank Group. IFC has provided financial and technical support that has helped the company conform to practices and standards of the Sustainable Rice Platform.

Contract is also identified as an influencing factor of SCI. The use of contract is highly recommended in agricultural business relationships. The companies should also consider the appropriateness of the level of term specificity, based on the characteristics of innovative practices and the level of trust and collaboration with partners. Detailed contracts that clearly specify the requirements and guidelines of the innovative practices are recommended because they can help to ensure that innovation practices are performed appropriately and effectively. In addition, it is suggested that managers should include performance-based rewards in the contract (Sumo et al., 2016) to give their partners additional motivation to implement innovative practices effectively. This is reflected in Rice SC 1, in which Rice company 1 uses the SRP framework to assess and reward farmers who satisfy the requirements of SRP rice.

It is also suggested that managers should define the objectives and requirements of innovations, and, depending on the nature of the relationship, should flexibly determine the level of collaboration and the most suitable type of control mechanism. For example, the partners can cooperate on the basis of contractual agreements (Rice SC 2), cooperative partnerships (e.g., sharing information, resources) (Coffee SC 2), or collaborations (e.g., joint planning and decision making) (Rice SC 1).

❖ Related to SCL

The study findings also indicate that SCL is a key determinant of SCI. It is suggested that managers should seek and create a strong learning culture across the supply chain. As asserted by Rice farmer 2, many training sessions, conferences and seminars are organised in a year, regardless of their usefulness and the applicability of the knowledge. Some farmers attended the events, encouraged by the local authorities, but did not find them useful. To avoid this situation, managers should develop proactive learning strategies rather than limiting the learning to passive absorptive learning, while also evaluating the effectiveness of each training session or conference by obtaining participants' feedback. It is noted that in addition to the learning achieved within the supply chain, information and knowledge from other stakeholders such as academics, government and even competitors in the industry are critical to innovations (Aliasghar et al., 2019; Fu et al., 2013).

❖ Related to Awareness

As indicated from both the case study and survey findings, the awareness of and attitude to innovation of the supply chain members are prerequisites for the adoption and success of innovation. This factor is especially essential for farmers who have to shift from conventional to new and modern farming, with limited knowledge and a low level of education. The case studies have provided some evidence illustrating the complicated processes and failures of innovations due to farmers' lack of perception of the importance and benefits of the innovations, as well as their negative attitude towards the implementation of innovative practices (Rice SC 1 and 2). Managers should be also aware that breakthrough ideas may hit the wall of a partner's resistance to change. Thus, managers should invest time and effort in educating and raising awareness of the necessary and perceived benefits of innovation before implementation of innovation, as well as including it as a critical part of the innovation strategy.

❖ Related to SCP and ENU

This study explicitly reveals the influence of SCI on SCP in relation to different performance indicators such as time, cost, quality and responsiveness. This helps managers to be confident of high returns from the adoption of innovations. Developing a culture of innovation through which innovations are encouraged and promoted across the supply chain is likely to transform the supply chain (Rice supply chain 2). To achieve improved performance, managers should consider innovation as a priority and provide pathways to design and implement supply chain activities that encompass both upstream and downstream partners to create value and bring benefits to all stakeholders.

Demand uncertainties were indicated as an important factor that may weaken the influence of the impacts of SCI on SCP. Managers should bear in mind that innovation does not always result in expected outcomes under all conditions, and should pay attention to and provide regular updates on market demand and customer preferences when designing and implementing innovative activities. Faced with volatile demand, managers should attempt to reduce prediction errors by identifying potential factors that may affect product demand, and applying advanced technology such as big data analytics to produce more accurate forecasts of demand.

In conclusion, the findings draw the attention of managers to the importance of Contract, Trust, Learning, Collaboration and Awareness in SCI, enabling them to manage their business operations and supply chain activities in an effective and efficient manner, targeting successful innovation adoptions in the supply chain. The findings make a further contribution by identifying the likely significant impacts of SCI on SCP, which will help managers to not only adopt SCI but also develop an innovation culture within the chain. Finally, this study provides an understanding of the effects that demand uncertainties have on the relationship between SCI and SCP, thereby enabling managers to develop strategies for dealing with the uncertainties in an attempt to maximise the effectiveness of SCI implementation.

7.4.3.2 Policy recommendations

This study offers some implications for policymakers in Vietnam, as outlined next:

❖ Promoting collaborative model in the agricultural supply chain

First, it is important for policymakers to focus on promoting collaboration across participants in agricultural supply chains. In this regard, policymakers should focus on encouraging the formation and development of a new collaborative model of agricultural cooperative, like the cooperative model that has been operating in Rice SC 1. This model not only brings farmers together and supports them in terms of infrastructure development and technology assistance, but also eliminates the role of intermediaries in the supply chain by forming integrated supply chains and closed co-operation between farmers and downstream companies. It is suggested that policymakers implement policies that not only encourage the establishment of agriculture cooperatives, but also highlight the importance of such cooperatives. It is also necessary to provide adequate support to the cooperatives and farmers, such as financial and technology support, and trade promotion and market development to attract farmers to participate. Policies that encourage land consolidation and contract farming, and that promote the links between governments, scientists, farmers and businesses, are also important for enhancing collaboration among stakeholders within and outside the supply chain.

- ❖ Developing a more complete policy system that reduce barriers of innovation implementation

To achieve a more effective control mechanism across the supply chain, policymakers should consider and establish a favourable legal framework addressing related issues such as fairness in negotiation, sharing of benefits and risks, appreciating partnerships, and examination standards in agriculture. As perceived by the case study participants, Contracts are rarely respected, and the effectiveness of contracts is not great in the agricultural sector. Thus, it is necessary to develop a stronger contract law to ensure contract are enforced in agricultural supply chains. It is also suggested that policymakers should continuously adjust policies to support and motivate farmers to adopt modern farming practices, and to encourage investment in the processing industry to reduce the export of raw or preliminarily processed agricultural products. Policymakers should strengthen market regulation of food safety and quality and environmental regulations.

- ❖ Increasing intervention and investment in agricultural innovation

Innovations in agriculture require stronger intervention and higher investment by government. Thus, policies that prioritise investment in agricultural innovations, in particular, in science and technology, infrastructure, human resources, market development and research on agriculture, are strongly suggested. In addition, it is important to attract and promote investment by other economic sectors, and by international organisations, in order to leverage external investment and expertise in agricultural innovations.

- ❖ Enhancing knowledge and awareness towards integrated supply chain and innovation across the supply chain

It is suggested that policymakers should establish information network and research systems, and extend training to facilitate effective communication and knowledge sharing across the supply chain. It is also important to raise awareness of the importance of the interdependence of all stakeholders in an integrated supply chain in order to leverage mutual benefits and advantages. More importantly, policymakers should improve recognition of the significance of innovations in agriculture, and implement policies that encourage all supply chain stakeholders to adopt innovations.

7.5 Research limitations and directions for future research

Despite its contributions to the literature, this study has several limitations that are identified below. Directions for future research are also suggested below.

In line with most of the existing work, this study discussed SCI based on a uni-dimensional framework of innovation that focused only on the innovation approach (product, process and technology innovations), although the qualitative analysis helped to identify another dimension of innovation: the degree of innovation, including radical and incremental innovation. In addition, the complexity of the innovation process demonstrates the multi-dimensional nature of innovation (Camisón-Zornoza et al., 2004). Thus, future research should seek to take a comprehensive approach to integrating theoretical dimensions of SCI such as the approach, level of novelty and level of analysis of innovation.

In addition, in this study SCI is conceptualised as covering three common types of innovation: product, process and technology. It would be interesting to explore other types of innovations that are available in the literature but missing in the current study, such as marketing and managerial innovation towards a complete SCI (Gao et al., 2017). It is therefore suggested that future studies consider other types of innovations and investigate more complex innovations in the supply chain, targeting new and significant contributions in the field.

Another limitation of this study is that the research model was tested in the specific context of the Vietnamese agricultural supply chain, which may limit the generalisation of the findings. Future studies could overcome this limitation by conducting a cross-national study or a comparative study involving a number of countries.

Finally, in case study research, longitudinal data is not available to gauge the impact of antecedents such as collaboration on innovations, or of innovation on supply chain performance. Furthermore, innovation constitutes dynamic capability-building and is therefore subject to change over time (Teece & Pisano, 1994). Hence, longitudinal investigation is suggested for subsequent research in order to fully understand the complex antecedents-SCI and SCI-SCP relationships.

7.6 Conclusion

SCI has received increasing scholarly attention over recent years. The importance of influential factors and the outcomes of SCI have been frequently highlighted in the literature. However, the literature on these factors and outcomes has been still fragmented. The relevant studies conducted to-date are primarily based on varied conceptualisations of SCI such as a particular type of innovation (e.g., product, process or technological innovation), innovativeness, or innovation capability. In addition, there has been a lack of investigations in the context of a supply chain that involves multiple stakeholders, both inter- and intra-organisation and covers different core functions that span across a supply chain. To address these gaps, specific relationships that have been less studied or mostly unexplored in the literature are the focus of this research study where the impacts of Contract and Trust on SCI, which are mediated by SCC, the link between Learning and SCI, and the influence of SCI on SCP have been researched. In particular, the empirical data from Vietnamese rice and coffee supply chains were collected to explore these relationships, involving important functions in the supply chain including growing, processing, distributing and trading. This study comprised of 2 phases: qualitative (phase 1) followed by a quantitative (phase 2). In phase 1, four in-depth case studies were conducted to explore, validate and enrich the conceptual model and the survey instruments required for Phase 2. Consequently, qualitative finding suggested the important role of Awareness on SCI, which has been missing in the literature. The revised model was then tested using surveyed data collected from 318 actors in the supply chains during Phase 2.

The findings confirmed the importance of Contract, Trust, SCC, SCL and Awareness for SCI across these two Vietnam‘s supply chains. Among these factors, SCC and Trust were found to be the most important influential factors that are strongly associated with SCI. Added to this, the findings confirmed the mediating role of SCC in enhancing the effects of Contract and Trust on SCI. This study also indicated that the adoption of SCI greatly enhances the overall performance of the supply chain, but the SCI-SCP linkage is moderated by Demand Uncertainty. Given these findings place this study in the vanguard of investigations of these particular relationships in an integrated model.

The novelty of this study lies in the way it has extended and made new contributions to TCT and DCT accordingly. Employing the rigorous design of a mixed-methods approach, this study has also contributed to a richer and more comprehensive understanding of SCI, its antecedents and consequences, especially in the context of agricultural supply chains. However, it was not without its challenges. Conducting this study using mixed methods design, which was based on a combination of inductive and deductive enquires involved the double processes of collecting and analysing both the qualitative and quantitative data. Especially, the large sample size of the quantitative data collected using face-to-face surveys across eleven provinces in Vietnam also required much time and effort as well as engagement with the respondents during the data collection. However, managing and overcoming these challenges has indeed contributed to a more reliable dataset and more robust findings.

Through establishing the critical influential factors and the outcomes of SCI, this study helps to stimulate SCI implementation and success, leading to an overall improved SCP. In particular, the findings of this study conducted across coffee and rice supply chains forms the basis for supply chain or innovation practitioners to move towards better decision making and management of their supply chain activities and adoption of innovative practices. This work also offers a number of important policy recommendations to assist with increasing both investment and productivity in agriculture in Vietnam.

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APPENDICES

Appendix 1: Interview invitation letter

INVITATION LETTER

Antecedents and Consequences of Supply chain innovation
Empirical evidence from Vietnamese agricultural supply chain

Dear Sir/Madam,

My name is Phi Yen Phan and I am a lecturer at the University of Economics and Law, under Vietnam National University, Ho Chi Minh city. I am currently doing research in Australia as a research scholar at the University of Technology, Sydney (UTS). My principal supervisor is Associate Professor Renu Agarwal.

We are conducting research into investigating the determinants and outcomes of supply chain innovation, which are imperative for the implementation and success of innovation in the supply chain. I would welcome your assistance to my research because your valuable knowledge and experience are deemed significant for innovation in agricultural supply chain. Your assistance will involve answering a set of pre-planned questions and/or follow-up questions that should take no more than 90 minutes of your time.

Please be assured that you are under no obligation to participate in this research and you can change your mind at any time without consequences. In case that you agree to be part of the research, we ensure that any information given will be treated as strictly confidential and the data gathered will be published in a form that does not identify you.

If you are interested in participating, please feel free to contact me (us) via email or phone as below contact details or local independent person (Dr Trung Thanh Ho, Head of Faculty of Information Systems, University of Economics and Law, Email: thanhht@uel.edu.vn, Mobile: +84)

Yours sincerely,

Phi Yen

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Appendix 2: Participant information sheet and consent form

PARTICIPANT INFORMATION SHEET

Antecedents and Consequences of Supply chain innovation
Empirical evidence from Vietnamese agricultural supply chain

WHO IS DOING THE RESEARCH?

My name is Phi Yen Phan, and I am a PhD student at UTS. My doctoral supervisors are A/P Renu Agarwal (Renu.Agarwal@uts.edu.au), A/P Christopher Bajada (Chris.Bajada@uts.edu.au) and Dr Sanjoy Paul (Sanjoy.Paul@uts.edu.au)

WHAT IS THIS RESEARCH ABOUT?

The research aims to investigate determinants and outcomes of supply chain innovation, using empirical data from Vietnamese rice and coffee supply chain. The expected findings of this research will assist in stimulating supply chain innovation implementation and success, which in turn will lead to an overall improved performance of agricultural supply chain as well as that of Vietnamese agriculture.

WHY HAVE I BEEN ASKED?

Your organisation and your staff have been invited to participate in this study because of the nature of your organisation (agri-business). Your organisational contact details were obtained from the lists/reports that are publicly available on the Websites of Vietnamese Government (i.e. Department of Agriculture and Rural Development, Department of Planning and Investment).

IF I SAY YES, WHAT WILL IT INVOLVE?

If your company and your staff decide to participate, your staff's assistance will involve one or more of the following:

- Participating in a semi-structured interview that will take approximately 60 to 90 minutes and will be audio recorded and transcribed.
- Answering a questionnaire that will take approximately 45 minutes to complete and will be audio recorded.

ARE THERE ANY RISKS/INCONVENIENCE?

Please be assured that all information given will be kept strictly confidential. The questionnaire and audio files will be securely stored and data/transcript obtained from those will be de-identified. In the unlikely event that your staff (interviewee) may experience inconvenience, he/she is able to stop the interview at any time without consequence. In addition, to minimise any possible inconvenience to your staff, the time and location of this interview will be predetermined based on his/her choice to ensure his/her comfort and privacy.

DO I HAVE TO SAY YES?

Participation in this study is voluntary. It is completely up to you whether or not you and your staff decide to take part.

WHAT WILL HAPPEN IF I SAY NO?

If your organisation and your staff decide not to participate, it will not affect your relationship with the researchers or any organisation related such as the University of Technology Sydney, or the University of Economics and Law under Vietnam National University. If your organisation and your staff wish to withdraw from the research once it has started, your organisation and your staff can do so at any time without having to give a reason, by contacting PhiYen.Phan@student.uts.edu.au or yenpp@uel.edu.vn. If you and your staff withdraw from the study, your samples and the transcripts will be destroyed.

CONFIDENTIALITY

By signing the consent form, your organisation consent to the research team collecting data for the research project. All this information will be treated confidentially. All data collected will be stored securely in a cloud with access limited to the researcher and her supervisors. Your information will only be used for the purpose of this research project.

We would like to store your information for future use in research projects that are an extension of this research project. In all instances your information will be treated confidentially.

We plan to publish the results as part of the thesis. In any publication, information will be provided in such a way that your organisation cannot be identified.

WHAT IF I HAVE CONCERNS OR A COMPLAINT?

If you have concerns about the research, please feel free to contact me at PhiYen.Phan@student.uts.edu.au or my principal supervisor at Renu.Agarwal@uts.edu.au or local independent person (Dr Trung Thanh Ho, Head of Faculty of Information Systems, University of Economics and Law, Email: thanhht@uel.edu.vn, Mobile: +84 [redacted])

You will be given a copy of this form to keep.

NOTE:
This study has been approved by the University of Technology Sydney Human Research Ethics Committee [UTS HREC]. If you have any concerns or complaints about any aspect of the conduct of this research, please contact the Ethics Secretaries on ph.: +61 2 9514 2478 or email: Research.Ethics@uts.edu.au], and quote the UTS HREC reference number as ETH-182961. Any matter raised will be treated confidentially, investigated and you will be informed of the outcome

UTS UNIVERSITY OF TECHNOLOGY SYDNEY

CONSENT FORM

Antecedents and consequences of Supply chain innovation
Empirical evidence from Vietnamese agricultural supply chain

UTS HREC approval number: ETH-182961

I,____________________ agree to participate in the research project – as per the title – being conducted by Phi Yen Phan, UTS Business School.

We have read the Participant Information Sheet or someone has read it to us in a language that we understand.

We understand the purposes, procedures and risks of the research as described in the Participant Information Sheet.

We have had an opportunity to ask questions and we are satisfied with the answers we have received.

We freely agree to participate in this research project as described and understand that we are free to withdraw at any time without affecting our relationship with the researchers or the University of Technology Sydney and the University of Economics and Law under Vietnam National University.

We understand that we will be given a signed copy of this document to keep.

We agree to be:
☐ Audio recorded

We agree that the research data gathered from this project may be published in a form that:
☐ Does not identify us in any way
☐ May be used for future research purposes

We are aware that we can contact Phi Yen Phan or her principal supervisor or the local independent contact person if we have any concerns about the research.

____ ____/____/____
Name and Signature [participant] Date

____ ____/____/____
Name and Signature [researcher] Date

Appendix 3: Qualitative interview protocol

INTERVIEW PROTOCOL

Antecedents and Consequences of Supply Chain Innovation
Empirical evidence from Vietnamese agricultural supply chain

Interview code:…………………….
Interviewee:……………………..
Date:…………………………………..
Time:……………………………….
Length of interview:…………………………..

A- INTRODUCTION

- Summary of the intent and procedure of the interview
- Tape recording
- De-identify all information
- Seek agreement on process

B- DEMOGRAPHICS

1. **Please tell me about yourself.**
   - What is your education level and current position in your business?
   - How long have you been working in this company and in this position?
   - Tell me about your working experience before being employed in your current position?

2. **Please tell me about your business.**
   - When was your business started? And what is the type of ownership structure of your business? How many employees do you have in your business?
   - What was your total turnover for 2018? What was your production output/yield in 2018 (tonnage or kilogram)?
   - Tell me about your largest/most important supply chain partners: What percentage of your input/output is traded with them?

C- SUPPLY CHAIN INNOVATION, ITS ANTECEDENTS AND CONSEQUENCES

3. **Supply chain innovation**
   - Did you often innovate like trying out new ideas or being active in finding new ways to do things in your business and your supply chain? How? Did your supply chain partner(s) do the same or join with you?
   - Did you and your supply chain partner frequently implement innovative practices regarding:
     - Product innovation (i.e., improve existing products or develop new products)
     - Process innovation (i.e., improve the existing processes or introduce new processes in operations and supply chain activities)
     - Technology innovation (i.e., technologies used, pursue new technologies in the industry?
   - Which of the previously mentioned practices that you consider as most important and focus on it?
   - What are other practices that you have implemented and considered them as innovativeness?

(*Note: Probing questions will be also asked i.e. ~~–~~How/in what way?", ~~–e~~xamples supporting arguments?"

4. **Determinants of supply chain innovation**

- Please tell me your situation/experience in regard to the following factors:
    - **Trust:** Do you totally trust your supply chain partner? How did they behave or work with you when you did not monitor them?
    - **Contract:** Did you use any contract to cooperate/govern the relationship with your partner? What kind of the contract?
    - **Collaboration:** Did you collaborate with any supply chain partner? How do you collaborate?
    - **Learning:** Did you and your supply chain partners usually learn from each other to improve/change your behaviours and processes? How? What did you do after you gain knowledge from learning?
- How did the above factors affect your business, especially in terms of adopting innovative practices?
- What are other factors that you consider as significantly affect your capability and success of implementing innovation? And why?

5. Outcomes of supply chain innovation

- What are the outcomes of the implemented innovative practices that they have contributed to these indicators: delivery, product quality, costs (production, transport, inventory etc.), customer satisfaction, lead time (which elapses between the receipt of customer order and the delivery of the products)?
- What are other benefits of the innovative practices that you adopted?

6. The effects of environmental uncertainties

- How was about the stability of customer demand of your product? Is it hard to predict?
- How was about the technology development in your industry?
- Did they affect the relationship between your innovation activities and their associated benefits?

7. Do you have any other comment or suggestion?

(**Note: Use signposts in between and summarise key findings at the end of the interview)

Appendix 4: Quantitative survey questionnaire

RESEARCH SURVEY QUESTIONNAIRE

Antecedents and Consequences of Supply Chain Innovation
Empirical evidence from Vietnamese agricultural supply chain

Code [ ]

The purpose of this survey is to provide information to enable investigation of determinants and outcomes of supply chain innovation in Vietnamese rice and coffee supply chain. The findings of this study will assist in the implementation and success of supply chain innovation, which in turn will lead to an overall improved performance of the supply chains as well as Vietnamese agriculture.

All information that you provide would be kept strictly confidential. *The survey includes the following* ***six*** *sections:*

SECTION 1. BUSINESS INFORMATION

1. When was your business started?

☐ Before 1990 ☐ From 1991 – 1999

☐ From 2000 – 2009 ☐ From 2010 – 2018

2. What is the type of ownership structure of your business?

☐ Sole proprietorship ☐ Limited liability company

☐ Partnership ☐Others (Please specify): ....

3. Which province is your main centre of operation of your business?...

4. What are the names of the city/town/village where your business operates?

....

5. Which of the following best describes the nature of your business?

☐ Grower ☐ Processor (roaster/miller) ☐ Distributor/Exporter/Wholesaler/Retailer

6. Which of the following products that your business is trading?

☐ Rice ☐ Coffee

7. How many employees do you have in your business? ....

8. What was your total turnover for 2017? ....

9. What is your production output/yield in 2017 (tonnage or kilogram)? ....

10. What percentage of your input/output is traded with your largest/most important supply partner?

☐ 1% - 24% ☐ 25% - 49%

☐ 50% -74% ☐ 75% - 100%

11. Does the largest/most important supply chain partner reside in the same province?

☐ Yes ☐ No

*** Note: From the following question 12 to question 47, please indicate the degree of your agreement with the following statements by CIRLING the number that is appropriate:**

Strongly disagree	Disagree	Somewhat disagree	Uncertain	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7

SECTION 2. DETERMINANTS OF SUPPLY CHAIN INNOVATION: TRUST, CONTRACT, COLLABORATION AND LEARNING

Please indicate to the extent to which you agree with the following statement in regard to your firm and your ***most important supply chain partner.***

TRUST:							
12. Your partner is trustworthy.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. Your partner always keeps their promises made to you.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14. Without monitoring, your partner always tries to fulfill their obligations.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15. You believe to the information that your partner provides to you.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CONTRACT							
16. Contract is used to govern the relationship between you and your partner	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17. Contract is used to manage your partner‘s behaviours	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18. You seems to communicate effectively with your partner when using detailed contract in which the details of cooperation are fully listed.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
COLLABORATION							
19. You and your partner usually share risks (i.e., loss on order changes, reduced buy prices).	**1**	**2**	**3**	**4**	**5**	**6**	**7**
20. You and your partner usually share resources (i.e., machinery, technologies, technical support) to help each other improve capabilities.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
21. You and your partner jointly making decision (e.g., planting, harvesting schedule, input materials) and developing strategies for implementing innovative practices.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
22. You and your partner have frequent contacts on a regular basic.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
23. You and your partner collaborate in implementing operational activities.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

LEARNING							
24. You constantly learn better ways to operate (i.e. through getting ideas about new ways of working or looking at different approaches used by your supply chain partners)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
25. You learn better ways of working with your supplier and serve your customer	**1**	**2**	**3**	**4**	**5**	**6**	**7**
26. Your partner also learns better ways to manage their business and work with you.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
27. You change or improve your behaviors and processes in accordance to the new knowledge gained from SC partners	**1**	**2**	**3**	**4**	**5**	**6**	**7**
28. Learning (about market, customer, or fundamental changes in the industry i.e. technology, regulation) is stimulated and shared across the SC	**1**	**2**	**3**	**4**	**5**	**6**	**7**
AWARENESS (& ATTITUDE TOWARD SCI)							
29. We are aware that SCI is very important and can bring many benefits to our firm/farms and that of the entire SC	**1**	**2**	**3**	**4**	**5**	**6**	**7**
30. We are willing to make changes/improvements and implement innovative practices	**1**	**2**	**3**	**4**	**5**	**6**	**7**
31. We can ensure to respect and strictly apply innovative practices regarding their processes, procedures and regulations.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

SECTION 3. SUPPLY CHAIN INNOVATION

Please indicate to the extent to which you agree with the following statement in regard to your firm and your ***most familiar supply chain partner(s).***

32. You with supply chain partners frequently try out new ideas in the supply chain context.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
33. You with supply chain partners are creative in the methods of operation in your supply chain.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
34. You with supply chain partners often introduce new products or improve existing products.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
35. You with supply chain partners have formal new product development process.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
36. You with supply chain partner pursue continuous improvement in core processes in your supply chain	**1**	**2**	**3**	**4**	**5**	**6**	**7**
37. New process introduction in the supply chain has increased over the last 5 years	**1**	**2**	**3**	**4**	**5**	**6**	**7**

38. You with supply chain partners are using technologies in implementing supply chain activities (i.e., tracking & tracing system, internet-based practices, technologies 4.0)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
39. You with supply chain partners pursue new technologies	**1**	**2**	**3**	**4**	**5**	**6**	**7**
40. You with supply chain partners focus on process and technology innovation.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

SECTION 4. SUPPLY CHAIN PERFORMANCE

Please indicate to what extent do you agree with the following statement in regard to your firm and your ***most important supply chain partner(s).***

41. You delivers on-time and accurate order to your supply chain partners.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
42. You are able to quickly respond your supply chain partners in term of product mix, quantity and/or special requirement.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
43. You have achieved a significant cost reduction (e.g., purchasing, production, transport, and/or inventory cost).	**1**	**2**	**3**	**4**	**5**	**6**	**7**
44. You have improved your product‘s conformance to specification record to your supply chain partners.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
45. You have improved your product quality record to your supply chain partners.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
46. You have increased customer satisfaction record to your supply chain partners.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

SECTION 5. THE EFFECT OF ENVIRONMENTAL UNCERTAINTIES

Please indicate to what extent do you agree with the following statement in regard to your firm and your firm'*s* ***primary product or industry.***

47. The consumer demand is very unstable.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
48. It is hard to predict customer demand and preference.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
49. Technology in your industry change rapidly	**1**	**2**	**3**	**4**	**5**	**6**	**7**
50. It is difficult to implement production technology due to due to their high cost, investment and requirement of economic of scale.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

SECTION 6. INFORMATION ON THE RESPONDENT

51. Gender:

☐ Male ☐ Female

52. How old are you?

☐ 18 – 34 ☐ 35 – 44
☐ 45 – 54 ☐ 55 – 64
☐ More than 65

53. Your education level:

☐ Postgraduate (Masters/PhD/DBA) ☐ Secondary/high school education
☐ Undergraduate (Diploma/Bachelor degree) ☐ Others (Please specify): ....

54. What is your title in the company? ....

55. How long have you been working in this position?

☐ 0 – 2 years ☐ 3 years – 5 years
☐ 6 years – 9 years ☐ More than 10 years

56. How long have you been working for this company?

☐ **0** – 2 years ☐ 3 years – 5 years
☐ 6 years – 9 years ☐ More than 10 years

57. What was your previous working experience before being employed in your current position?

☐ Production and operations ☐ Purchasing
☐ Sales and marketing ☐ Logistics and supply chain management
☐ Banking and Financing ☐ Others (Please specify): ....

Thank you very much for your cooperation!