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A Knowledge Mobilisation Framework for Lean Supply Chains in Agri-food Industry

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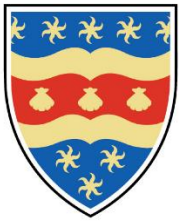

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A Knowledge Mobilisation Framework for Lean Supply Chains in Agri-food Industry

By

Huilan Chen

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Copyright statement

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Author's declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee.

Work submitted for this research degree at the University of Plymouth has not formed part of any other degree either at the University of Plymouth or at another establishment.

Papers have been published and presented by the author based on the PhD work, and the full list of publications has been included on the next pages.

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Publications based on the PhD work

Journal articles

1. Guoqing Zhao, Jorge Hernandez, Sebastian Elgueta, Juan Pablo Manzur Shaofeng Liu, Huilan Chen, Carmen Lopez, Dulekha Kasturiratne and Xiaoning Chen, 2021. The impact of knowledge governance mechanisms on supply chain performance: empirical evidence from agri-food industry. Production Planning and Control 32(15): 1313-1336.
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3. Biljana Mileva Boshkoska, Shaofeng Liu, Guoqing Zhao, Huilan Chen, Alejandro Fernandez, Susana Gamboa, Mariana del Pino, Pascale Zarate, Jorge Hernandez, 2019. A Decision support system for evaluation of the knowledge sharing crossing boundaries in agri-food value chains. Computers in Industry 110: 64-80.
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16. Guoqing Zhao, Shaofeng Liu, Huilan Chen, Carmen Lopez, Jorge Hernandez, Cécile Guyon, Rina Iannacone, Nicola Calabrese, Hervé Panetto, Janusz Kacprzyk and

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Huilan Chen

A Knowledge Mobilisation Framework for Lean Supply Chains in Agri-food Industry

Abstract

Agri-food supply chains (AFSCs) play an important role in achieving United Nation's Sustainable Development Goal of reducing hunger. However, AFSC have many special characteristics, for example, the products flow through AFSCs are perishable, have relatively short shelf-life and are exposed to rough and uncertain production environment (such as bad or unpredictable weather conditions). AFSC management usually requires concerted solutions and actions from the whole supply chain to avoid severe various risks and disasters. Increasing efficiency and eliminating waste across all stages of the AFSC have attracted great attention from researchers and practitioners in recent years. This calls for the exploration of classic lean principles and developing new lean management approaches. This project sets the research context in AFSC and focuses on investigating knowledge mobilisation across boundaries for achieving lean performance, that is, to eliminate any non-value-adding activities and use of resources in AFSC.

This study adopted a mixed-methods approach by combining semi-structured interviews and a questionnaire survey to collect empirical data from AFSC stakeholders. The empirical study consists of two phases: a qualitative phase and a quantitative phase. During the qualitative phase, semi-structured interviews were conducted with AFSC stakeholders from seven countries across Europe (UK, France, Italy, Poland and Spain) and South America (Chile and Argentina). The interview data were analysed using thematic and comparative analysis. During the quantitative phase, over 300 valid survey questionnaires were collected and analysed through Structural Equation Modelling (SEM) method.

Main findings of the study include the development and validation of a Knowledge Mobilisation (KMob) framework. A conceptual KMob framework was developed via a

Systematic Literature Review (SLR). The conceptual KMob comprises three key building blocks: (1) key factors affecting knowledge mobilisation in AFSC; (2) boundary-spanning mechanisms; and (3) supply chain lean performance KPIs. Based on the data from the qualitative phase, an empirical KMob framework is developed which refines the content of the building blocks. Two categories of boundary-spanning mechanisms in the second building block (i.e. boundary practice and boundary discourse) were removed, one new category of the boundary-spanning mechanism (i.e. boundary interactions) was added, and two other categories (i.e. boundary objects and boundary spanners) were extended and enriched with new meanings. In the first building block, three out of eleven key factors (continuous improvement, time and cost) were also removed. By the end of the quantitative phase, the relationships between the second and third building blocks have been quantified in the context of lean management in AFSC, hence the resulting KMob framework at the end of quantitative phase is considered validated.

There are both theoretic and practical contributions from the study. Firstly, an innovative KMob framework has been developed. It is the first systematic KMob framework addressing knowledge mobilisation across boundaries in AFSC. This KMob framework makes clear contribution to new knowledge. Secondly, the KMob framework has been empirically tested and validated in AFSC, demonstrating positive impact of three categories of boundary-spanning mechanisms (i.e. boundary objects, boundary spanners and boundary interactions) on five supply chain lean performance KPIs (i.e. inventory reduction, quality assurance, lead-time reduction, on-time delivery and smooth operations flow). It is the first time the impact relationships were quantified in real AFSC at such big scale (crossing geographic, cultural, social and organisational boundaries). Thus, the findings have managerial implications for knowledge management, supply chain management and lean management.

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List of abbreviations

AFSC: Agri-food Supply Chain

AHP: Analytic Hierarchical Process

KMob: Knowledge Mobilisation

KBV: knowledge-Based View

KPI: Key Performance Indicator

RUC-APS: Risk and Uncertain Conditions for Agricultural Production Systems. RUC-APS is a six-year (2012-2022), collaborative project funded by European Commission under the Horizon 2020 programme. Project website: https://ruc-aps.eu/

SC: Supply Chain

SCM: Supply Chain Management

VMI: Vendor Managed Inventory

ECR: Efficient Consumer Response

CPFR: Collaborative Planning, Forecasting and Replenishment

SEM: Structural Equation Modelling

SLR: Systematic Literature Review

CFA: Confirmatory Factor Analysis

SPA: Boundary Spanners

OBJ: Boundary Objects

INT: Boundary Interactions

INV: Inventory Reduction

QUA: Quality Assurance

TIM: Lead-time Reduction

DEL: On Time Delivery

SMO: Smooth Operation Flow

RMSEA: Root Mean Square Error of Approximation

GFI: Goodness-of-Fit Index

SRMR: Standardized Root Mean Squared Residual

CMIN/DF: Chi-square Fit Statistics/Degree of Freedom

Chapter 1 Introduction

1.1 Research context

Agri-food supply chains (AFSC) are comprised of linked events and activities in the agricultural production system, which involve all stages from farming to food processing, testing, packaging, warehousing, transportation, distribution, retailing and consumption, literally "from farm to fork" (Zhao et al, 2021). The AFSC has received enormous attention because of its key role in achieving United Nations Global Challenges Goal of reducing hunger. Compared with other types of supply chains, AFSC have many special features which will require special attention from management perspective. For example, Products flowing through AFSC are usually perishable, have relatively short shelf-life but long production throughput time, and the agri-food products' availability can be significantly constrained by seasonality (Chen, Liu & Oderanti, 2017; Stone & Rahimifard, 2018).

AFSC are usually complex (i.e. filled with uncertainty and risks). Different stages of the supply chain are exposed to very different environment, from indoor to outdoor, and can be affected by a wide range of unpredictable factors from weather to market demand. In order to make sure that AFSC can provide sustainable, affordable, safe, and sufficient food, feed, fibre and fuel to consumers, it is critical that AFSC can operate smoothly and efficiently to achieve "lean" performance (Chen et al, 2019). By definition, "lean" principles have developed from manufacturing systems primarily focused on eliminating waste (i.e. non-value-adding activities) into management approaches addressing both waste elimination and variability reduction from a supply chain perspective (Garcia-Buendia, Moyano-Fuentes & Maqueira-Marín, 2021).

Knowledge has been recognised as one of the key business assets that can give organisations and supply chains long-lasting competitive advantages, hence knowledge management has played an important role in the current knowledge economy. In the context of AFSC, knowledge mobilisation across different stages of the supply chain is crucial to achieving lean

supply chain performance. However, knowledge mobilisation crossing supply chain stages has presented many challenges, not only because stakeholders at different stages of the AFSC have different expertise areas, but also may have different level of interests in sharing knowledge with others (Boshkasha, Liu & Chen, 2018; Zhao et al, 2020b). Furthermore, various boundaries (such as resulted from technological, social, cultural and political factors) may exist that could erect barriers to knowledge mobilisation. There is a great need to understand the challenges and identify the knowledge barriers, in order to search for solutions to successfully mobilise knowledge crossing the boundaries (Liu, 2020), further to find out how knowledge mobilisation will affect AFSC towards achieving lean performance.

The term "knowledge mobilisation" is used in this study instead of many other well-known terms (knowledge transfer, knowledge exchange, knowledge flow, knowledge sharing, knowledge diffusion etc.) to highlight the fact that for knowledge to be mobilised, especially in crossing-boundary situations, significant effort is required from both sides involved in the knowledge activities, including both knowledge senders and receivers. Sometimes, it may require significant effort from third parties such as knowledge facilitators, who are often called knowledge spanners in the case of crossing knowledge boundaries in supply chain stages. Through the effort from both sides (and sometimes third parties), knowledge is not only mobilised, but also improved and renewed. However, knowledge mobilisation should not be interpreted as a straightforward process which simply passes knowledge from one to another. It requires the knowledge seekers, requesters or even knowledge brokers to put significant amount of effort and commitment to absorbing the knowledge and exercise their learning and reflection in order to create new knowledge (Phelps, Heidl, & Wadhwa, 2012; Liu et al, 2019; Liu, 2020).

1.2 Research problem

Nowadays, the agri-food industry is facing challenges that have never been seen before. First,

it is a highly competitive commodity industry. Many suppliers, like farmers are price takers and having weak negotiating positions. Although there is considerable room for differentiation among downstream producers and retailers, they are also under intense and effective pressures to lower prices. As problems above, one source of differentiation is the food itself. Farmers have to adapt innovative practices to create unique branded products (Bhat & Jõudu, 2019). However, farmers have found it difficult to find qualified personnel. In fact, even though the people lived in a rural area, many of them had no knowledge of agriculture. In addition, the agri-food industry is tightly connected to the natural environment. Farming is completely dependent on basic resources, such as land, air and water. There is evidence showing that many of the current food production systems are harming the planet and its inhabitants (Parajuli, Thoma & Matlock, 2019). Thus, the knowledge of how suited the crops are to their surroundings is important to conserve the environmental balance. Farmers have to learn to pay close attention to the crops so that they only use artificial substances when absolutely necessary. Finally, there is a challenge to facilitate the transportation of agri-food products towards consumption zones as soon as possible in order to assure food quality, safety and authenticity. Improper attention to this issue can affect farmer income and the environmental impact of food products. One of the solutions is to optimise the packaging and transportation stations by incorporating new processes such as sorting, freezing, ferrying and stocking (Joshi, Singh & Sharma, 2020). However, for the perspective of agri-food supply chain, the actors involved in the chain often belong to different companies, collaborative knowledge sharing in supply chains is difficult.

1.3 Research aim, objectives and questions

The overall aim of this study is to develop a knowledge mobilisation framework that can help improve lean performance in agri-food supply chains. In order to realise the overall aim, five specific research objectives have been defined:

(1) to understand the state of the art on knowledge mobilisation in agri-food supply chains in order to establish a solid theoretical foundation and provide justification for the PhD project;

(2) To develop an innovative knowledge mobilisation framework that focuses on crossing knowledge boundaries in agri-food supply chains;

(3) To validate the knowledge mobilisation framework in agri-food supply chains by assessing its impact on improving the supply chain's lean performance;

(4) To reflect on the developed knowledge mobilisation framework by comparing it with the state of the art for theorisation;

(5) To derive recommendations for future research directions and implications for management practice.

To help the author to keep focused on achieving the research objectives, three clear research questions have been formulated. By finding answers to the three research questions, the research objectives can be achieved. The three research questions are:

- RQ1. What are the key factors affecting knowledge mobilisation in agri-food supply chains?
- RQ2. How to cross knowledge boundaries (i.e. by using what boundary spanning mechanisms) in agri-food supply chains?
- RQ3. What is the impact of the boundary spanning mechanisms on agri-food supply chain lean performance?

1.4 Research justification

Knowledge Management (KM) is still a relatively young field compare with supply chain management, however, it has gained enormous popularity in last few decades. Even though KM related activities were around for quite long time, for example those undertaken by librarians, philosophers and information systems developers and users, most scholars agree that

the term “knowledge management” started to gain popularity in 1980s, when some dedicated conferences were held, and some books were published on the topic. Researchers’ attention to KM was further sped up in 1990s when more systematic study and deliberate leveraging knowledge assets were undertaken. More and bigger scale international conferences took place and more and bigger consortia were formed, which marked the starting point of KM emerging as a distinctive field of study (Boshkasha, Liu & Chen, 2018; Liu, 2020). The popularity of KM research continued while scholars created international platforms to help sharing research findings and exchange ideas. Several dedicated international journals were subsequently launched. Most notably, Journal of Knowledge Management started publishing in mid-1990s, quickly followed by Knowledge Management Research and Practice in early 2000s. When moving into mid-2000s, the term of “knowledge economy” was coined in UK which announced the fact that the whole economy was driven by knowledge activities rather than physical resources or manual work. By then, KM had entered into all types of business activities and processes, including supply chain management (Shakerian, Dehnavi & Shateri, 2016; Chen et al, 2019).

Supply chain management, as a subject, was established and achieved maturity earlier than KM. Along with business globalisation, supply chains have become longer and more complex and encountered more and more uncertainties and risks which presented new challenges to managers and decision makers (Zhao et al, 2020). One of the consequences of supply chain internationalisation is that when more and more international partners participate in the supply chain activities, it becomes more and more difficult to coordinate and streamline the activities and relevant processes, which gives opportunities for non-value adding activities, such as repetitive work, internal transportation, more inventory accumulated along the supply chain, longer lead time, and slow delivery of final products to end customers. In summary, supply chain management is faced with efficiency issues. To tack the issues, researchers and

practitioners turned to the classic lean principles originated from manufacturing (Perez et al, 2010; Chen, Liu & Oderanti, 2017). The essence of lean approach is to eliminate non-value-adding activities and resources (i.e. termed "waste"). Lean manufacturing and management have been successfully implemented in many industries, especially in automotive and electronics started from Japan but soon around the world, in particular in major developed economies and countries (Garcia-Buendia, Moyano-Fuentes & Maqueira-Marín, 2021). In recent years, the importance and urgency of research on achieving lean supply chain performance has been recognised in agri-food industry to meet the United Nations Sustainable Development goal of reducing hunger (Panigrahi, Bahinipati & Jain, 2019).

It has been widely agreed that one of the key issues to achieve lean supply chain performance is to be able to effectively manage knowledge, because without knowledge sharing across the supply chain, it would be impossible to streamline supply chain processes to eradicate non-value-adding activities and resources. Most recently, a growing number of academics are looking into knowledge mobilisation within networks since members' combined information and experience may be the most significant source of value creation in complex supply chains and the knowledge-based approach offers new insight into the mechanism for updating and transferring techniques inside supply chains. Even though plenty of KM theories and frameworks had been created before KM was implemented in supply chain context, it became apparent to researchers that most classic KM theories and frameworks were created and applied at individual, group or within organisation situations (Shakerian, Dehnavi & Shateri, 2016). In other words, to date, the majority of knowledge mobilisation studies have kept an intra-organizational orientation. However, new inquiries about how to mobilise knowledge across organizational boundaries have appeared recently, which have added a fresh angle to the analysis and understanding of inter-firm collaboration. Liu (2020) discussed over 100 KM theories but very few of them were applicable to agri-food supply chains, and none of them

was concerned with achieving lean performance in agri-food industry. There is a clear gap in literature that no existing work systematically addressed the issue of knowledge mobilisation crossing boundaries in agri-food supply chains.

Effective KM requires structured and disciplined approaches that can provide robustness and consistency. One of the means is to have a clear, well-defined KM process, which has been proven a very popular approach. There have been hundreds of KM processes discussed in literature. Based on a comprehensive analysis of different stages of KM process models in literature, Liu (2020) proposed a four-stage KM process which include knowledge building stage, knowledge holding stage, knowledge mobilisation stage and knowledge utilisation stage. Compared with KM within an organisation, knowledge mobilisation stages are a particularly challenging issue in agri-food supply chains. There are a number of reasons (Liu et al, 2019; Zhao et al, 2020b):

- First, knowledge mobilisation in supply chains need to cross different stages of the supply chain, for example, from farming to food processing to distribution, and so on, to reach consumers;
- There are all sorts of factors that could create barriers to knowledge mobilisation from one stage of the chain to others;
- Products flowing through agri-food supply chains are characterised by perishability, shelf-life constraints and high uncertainty such as bad weather could wide out crops and produces in rapid speed. Knowledge mobilisation activities cannot afford any time delay which needs reliable and powerful, sometimes expensive, knowledge sharing channels;
- Compared with other types of supply chains, partners and stakeholders in agri-food chains are not necessarily educated or trained to a high level of knowledge. Many farmers at the upstream of the supply chain do not even use modern digital technologies,

let alone advanced knowledge management systems. A lot of farm businesses are family-owned, family-run SMEs without resources to have advanced infrastructure or facilities for knowledge mobilisation purpose.

Because of these reasons, knowledge mobilisation in agri-food supply chains has been an under researched area. There is a clear gap in literature in terms of effective knowledge mobilisation frameworks to help improve agri-food supply chain's lean performance (Garcia-Buendia, Moyano-Fuentes & Maqueira-Marín, 2021). To address the research gap in existing work, this PhD work will focus on understanding developing an innovative knowledge mobilisation framework for agri-food supply chains and will validate the knowledge mobilisation framework by assessing its impact on improving lean performance.

1.5 Key contributions

Key contributions from this study can be classified into two categories: contribution to new knowledge (i.e. theoretical contribution) and contribution to management practice (i.e. practical contribution). This study has investigated the research problem of knowledge mobilisation in agri-food supply chains, starting from identifying various factors that could create knowledge boundaries which hinder the knowledge mobilisation in supply chains, especially prevent knowledge mobilisation from one stage of the chain to other stages. Based on the understanding of possible knowledge boundaries in agri-food supply chains, this study proposed a range of boundary-spanning mechanisms which are classified into four specific groups: boundary objects, boundary spanners, boundary practice and boundary discourse. The study further examined the impact of boundary-spanning mechanisms on improving supply chain lean performance in agri-food industry. This study consists of a systematic literature review stage and an empirical stage. The empirical stages comprises both qualitative (via interview and thematic analysis) and quantitative phase (via questionnaire survey and analysis using SEM – Structural Equation Modelling).

Key theoretical contributions are summarised from the following four aspects:

- An innovative, systematic knowledge mobilisation framework has been developed. The knowledge mobilisation framework has three core building blocks: key factors that could create barriers/boundaries, boundary-spanning mechanisms and supply chain lean performance. Key factors within each building block have been identified. Relationships between the core building blocks are specified. This is the first systematic knowledge mobilisation framework developed for agri-food supply chains that is dedicated to crossing knowledge boundaries across different stages of the supply chain.
- The developed knowledge mobilisation framework has been validated in the agri-food industry. The impact from the boundary-spanning mechanisms on supply chain lean performance has been quantitatively established. Positive impact has been confirmed via SEM analysis based on a large sample size with empirical data collected from five countries across Europe (France, Italy and Spain) and South America (Chile and Argentina).
- A new category of boundary-spanning mechanism (i.e. boundary interactions) has been identified via empirical study in this PhD work. Various new elements have been identified for two types of existing boundary-spanning mechanisms (i.e. boundary objects and boundary spanners). The terms of these two boundary-spanning mechanisms were used in literature in product development and manufacturing context. This study has extended the literature by adapting them to agri-food supply chain context and has enriched the meanings of the mechanisms by adding new elements.
- The study has identified new success factors for knowledge mobilisation. The top ranked factors are collaboration, supply network structure and trust. These factors could have double-edge effect. It means that if they are not addressed properly, some of them could convert to barriers to knowledge mobilisation. For example, technology can be a

factor to facilitate knowledge mobilisation. Lacking support from appropriate technologies of misuse of technologies could create barriers. Using different technologies by different partners and stakeholders on the same supply chain could also create a technological boundary for knowledge mobilisation.

- The study has adapted the classic lean theory originated from manufacturing industry to agri-food industry, by refining five specific KPIs (inventory reduction along supply chain, quality assurance, lead-time reduction, on-time delivery of products to end customers, and smooth flow of operations across different stages of the supply chain) with new meanings that are suitable for agri-food supply chains.

This study has three key contributions to management practice, namely knowledge management, supply chain management and lean management.

- Knowledge management practice: the identified key factors, knowledge boundaries and boundary-spanning mechanisms can be used by knowledge management officers to better understand the key barriers that hinder knowledge mobilisation and how to cross knowledge boundaries in supply chain context. Apart from the three main types of knowledge boundaries (syntactic, semantic and pragmatic), this study also discussed other types of boundaries such as geographic, social, technological, organisational and cultural that can also create barriers to knowledge mobilisation.
- Supply chain management: smooth flow of materials and products is an essential requirement for all supply chains. Mobilising knowledge along the supply chain holds the key to enabling smooth flow of materials and products. It is a fact that different partners and stakeholders at different stages of a supply chain have different areas of expertise/knowledge and may have different level of interests in sharing knowledge with others. The knowledge mobilisation framework can help supply chain managers to quickly locate where particular boundaries may occur to erect barriers, and to

purposefully target those specific barriers by implementing suitable boundary-spanning mechanisms. In the knowledge mobilisation framework, there are alternative boundary-spanning solutions in each type of the mechanisms available to overcome knowledge boundaries. Each supply chain manager can choose to use the most appropriate solutions under different circumstances.

- Lean management: the knowledge mobilisation framework developed from this study provides quantified evidence of relationships between specific boundary-spanning mechanisms and particular lean performance KPIs. Practitioners can analyse their own performance objectives and decide for the most suitable KPIs to be implemented in their practice, then follow the links from the KPIs to employ the right boundary-spanning mechanisms. Lean practitioners can also adjust the parameters of boundary-spanning mechanisms and trace back to their preferred lean KPIs to conduct sensitivity analysis, in order to meet certain lean performance targets.

1.6 Thesis structure

This section describes the structure of the thesis and provides a brief overview of the chapters. The thesis comprises of in total seven chapters excluding references and appendices. Figure 1.1 illustrates the key elements in each chapter and the logical flow between different chapters.

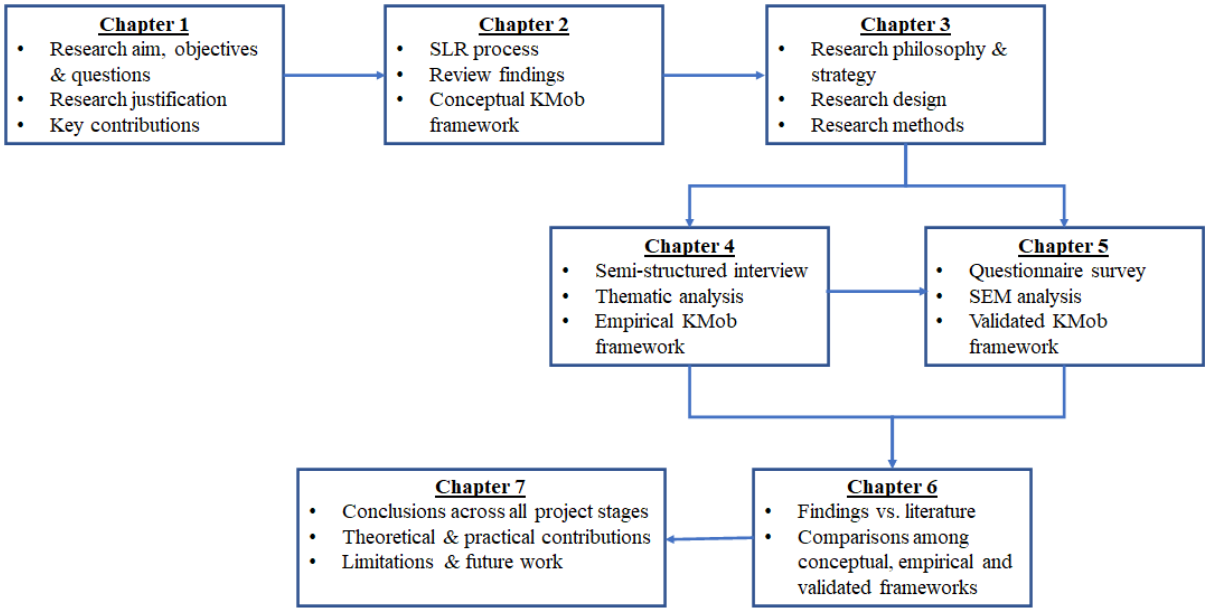


Figure 1.1: Structure of the thesis

Chapter 1 provides a general overview of the PhD study, introduces research aim, objectives and three research questions, gives justification for the research, summarises key theoretical and practical contributions, and illustrates the thesis structure.

Chapter 2 discusses in detail relevant literature to establish a solid theoretical foundation for the study. The chapter starts with the overall process of Systematic Literature Review (SLR) method. Two types of analysis (i.e. descriptive and thematic) included in the SLR and their findings are presented. Based on the SLR findings, research gaps are identified and a conceptual knowledge mobilisation (short for KMob) framework has been proposed.

Chapter 3 explains the research methodology. Firstly, various research philosophies and strategies are described and compared, then choices for the study is made. Research design is provided with details of stages of the plan and flow of logic between different stages. Research methods for data collection and analysis covering both qualitative and quantitative stages are selected and justified in this chapter. Research ethical issues are raised and discussed.

Chapter 4 is about the qualitative phase of the empirical study. This chapter explains how data has been collected via semi-structured interviews. Sampling strategy for qualitative stage is explained. Analysis of the data collected from interviews is detailed, starting from the thematic

analysis process. The chapter provides evidence of how relevant themes (knowledge boundaries, boundary-spanning mechanisms and lean performance KPIs) have been identified.

Chapter 5 focuses on the quantitative phase of the empirical study. This chapter includes questionnaire survey from design to administration to collect data from wide participants than that from semi-structured interviews. In total, over 300 valid questionnaires were returned and included in the analysis. The data collected via questionnaire survey have been analysed using SEM (Structural Equation Modelling) method. Findings from the quantitative phase are presented to test the relationships between boundary-spanning mechanisms and lean supply chain KPIs.

Chapter 6 discusses findings from the study. First, the chapter presents detailed comparisons among three knowledge mobilisation frameworks, that is, the conceptual KMob framework developed from Chapter 2, the empirical KMob framework developed from Chapter 4 and the validated KMob framework from Chapter 5. The comparisons establish clear differences and similarities to show the evolution of the KMob framework from literature study to empirical study, which provides evidence to draw conclusions in the next chapter.

Finally, **Chapter 7** draws conclusions across all stages of the whole PhD project. Theoretical (i.e. contribution to new knowledge) and practical (i.e. to management practice) contributions have been highlighted in this chapter. Various limitations of the study have been identified and recommendations for future research have been proposed to address the identified limitations.

1.7 Summary

This chapter introduced the research topic – how to cross knowledge boundaries in the agri-food supply chain for improving its lean performance. Overall research aim was set as developing an innovative knowledge mobilisation framework that could be used to cross knowledge boundaries. Five specific research objectives have been defined and three research questions have been formulated. These research objectives and questions will need to be

achieved and answered by the end of the thesis. Brief justification for research was provided. Key contributions to new knowledge and management practice were highlighted. The next chapter, Chapter 2, will review existing work related to the topic in order to establish solid theoretical foundation for this study.

Chapter 2 Literature review

2.1 Introduction

This chapter provides a systematic literature review (SLR) of the research topic. The main purpose for conducting the SLR is to identify, evaluate and interpret existing research relevant to sustainable agri-food supply chains, knowledge mobilisation as well as lean operations in the agri-food supply chains. Literature review is a crucial stage in the research project, outlining fundamental knowledge to establish theoretical foundations for the empirical study. SLR has been chosen because of its advantages over other review methods, including analysing literature in a disciplined and transparent approach and visualising systematic results of the extant research to minimise the chance of missing information or bias (Watson & Webster, 2020). The SLR process is described in detail in Section 2.2. Two types of analysis and their findings from the SLR are presented: descriptive analysis and its findings in Section 2.3 and thematic analysis and its findings in Section 2.4. Main research gaps based on SLR are discussed in Section 2.5 and a conceptual framework is proposed in Section 2.7.

2.2 Systematic literature review (SLR)

This section discusses the details of SLR method and the process of using SLR in this PhD research project. First, the background of SLR and justification for choosing it over other review methods are provided. Second, a five-phase process of using SLR is described in detail, including: (1) question formulation; (2) locating papers; (3) paper selection and evaluation; (4) analysis and synthesis; and (5) reporting the results.

2.2.1 Justification for using SLR as the review method

SLR is a review method developed by Professor David Denyer and Professor David Tranfield from the Management School at Cranfield University, UK. It is “a methodology that locates existing studies, selects and evaluates contributions, analyses and synthesizes data and reports

the evidence in such a way that allows reasonably clear conclusions to be reached about what is and what is not known" (Denyer & Tranfield, 2009). Compared with traditional literature review methods, SLR has a number of distinguished characteristics that made it a popular method in many fields, especially in management and social sciences (Melacini et al, 2018). Table 2.1 summarises some of the key differences between traditional literature review and SLR, highlighting research scope, research question, criteria for paper selection, research paper quality assessment and the synthesis of research results.

Table 2.1: Differences between SLR and traditional literature review (Tranfield, Denyer, & Smart, 2003)

Issues to consider	Traditional literature review	Systematic literature review
Research scope	A broad research scope	Narrow focus with a specific aim
Question formulation	Start with general discussion of subject	Start with clear review questions to be answered
Paper selection criteria	Inexplicit principles for the criteria	Define explicit criteria for paper selection
Research quality assessment	Do not consider differences in research methods or research quality	Predetermined criteria for quality assessment of theoretical foundation, research methods, data collection and data analysis
Research results synthesis	Do not differentiate between methodologically sound and unsound studies	Synthesis based on the most methodologically sound studies

Because of the lack of predetermined criteria for paper selection and quality assessment, it is inevitable that traditional literature reviews can summarize highly unrepresentative samples of studies which may easily lead to biased conclusions. However, systematic literature reviews provide a redress to researchers to be swayed by such biases (Denyer & Tranfield, 2009). Therefore, the systematic literature review has received much more attention to in recent years than traditional reviews. Besides, traditional literature review starts from a fairly broad scope,

sometimes includes randomly selected papers in the analysis, which makes it difficult for other researchers to replicate the findings or expand the review to future time period (Xiao & Watson, 2019). In contrast, systematic literature reviews usually aim to answer a specific question or specific review questions, rather than simply summarizing 'all there is to know' about a particular issue (Petticrew & Roberts, 2006; Kastner et al., 2012).

Systematic literature reviews can not only minimise biases and errors, but also can overcome information overload. There has been an explosion in the amount of research information available to researchers over the past few decades. Many new journals are launched every year and thousands of research papers are published every month, it is very difficult for even the most energetic researchers to keep up to date with the most recent research evidence. So, there is an urgent need to have review methods that can help researchers to organise and prioritise the most relevant information. Because systematic literature reviews define explicit inclusion and exclusion criteria as well as quality assessment criteria to select papers and evaluate each potential primary study, it is always easy to track how less relevant papers will be excluded steps by step when the predetermined criteria are applied to the whole collection of papers. In the end, only the most relevant papers that meet all inclusion criteria and quality assessment criteria will be left in the final collection to be included for analysis (Kitchenham, 2004).

Another key advantage of SLR is that it provides a well-structured, easy to follow process, which can guide researchers, especially the less experienced researchers, and help prevent their bias in selecting and evaluating papers for analysis. Even for more experienced researchers, having a clear process will help to produce more consistent, repeatable findings, no matter who is conducting the review. One of the important things in research is that for people to achieve shared understanding of existing work, in order to develop an agreed research agenda. SLR should be useful in this sense. The SLR process will be discussed in the next section in more details.

One disadvantage of systematic literature review is that it requires considerably more effort than traditional literature reviews. SLR may be difficult to implement for research that has to be completed within short time period, such as a dissertation project at UG or Master level. However, for this PhD project, SLR has been considered as an appropriate review method because of its advantages, while its disadvantage can be overcome (Keele, 2007; Kitchenham & Brereton, 2013).

2.2.2 Processes of SLR

A five-phase process for SLR was adopted in this work, as illustrated in Figure 2.1. These phases are described in detail in the following sub-sections.

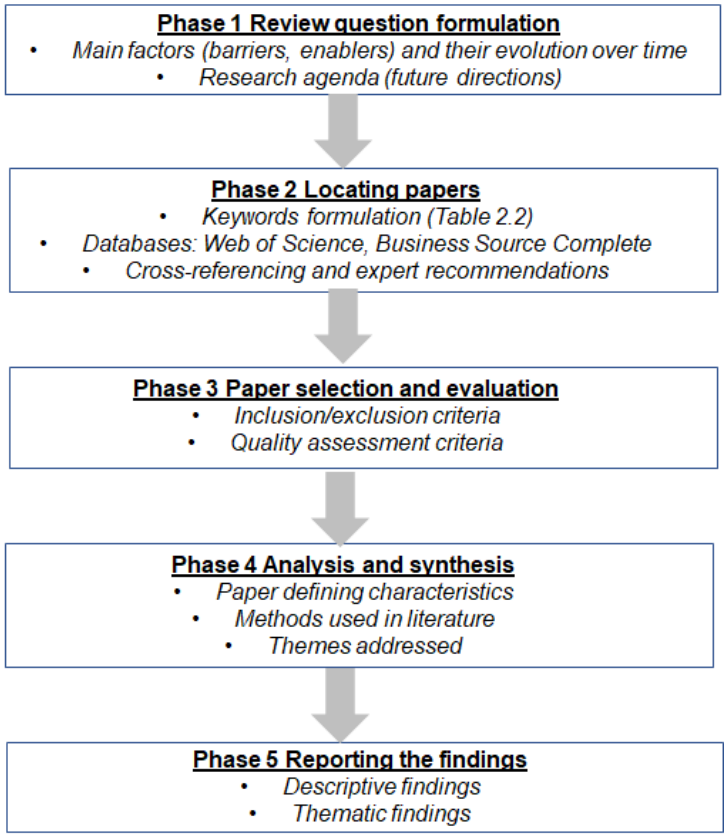


Figure 2.1: SLR process adapted from (Melacini et al, 2018)

Phase one: Question formulation

It is very important to have a clear research focus before a systematic literature review is

conducted, hence formulating a review question or a few review questions is a good start of the SLR process. In terms of how to formulate the right review question(s)? Denyer and Tranfield (2009) proposed the logic of CIMO for help formulate review questions. CIMO stands for Context, Intervention, Mechanisms and Outcome, which can help to specify four critical parts of a well-built systematic review question. According to the CIMO logic, a well-built literature review is framed with the following elements.

(1). Context: the setting where research is positioned. That is, which individuals, interpersonal relationships, institutional settings, or wider infrastructural systems are being studied? For example, if the research is situated in an agri-food supply chain, hence stakeholders at different stages of the chain would be farmers, food processors, distributors, retailers and consumers etc.

(2). Intervention: the effects of what events, actions or activities are being studied. For example, will the research examine the effects of knowledge mobilisation activities in the agri-food supply chain? If yes, what effect to focus on? How about the effect on supply chain lean performance?

(3). Outcomes: what are the intended and unintended effects of the intervention? How will the outcomes be measured? For example, will knowledge mobilisation activities in agri-food industry have a negative or positive effect on supply chain lean performance? What KPIs can be used to measure the supply chain lean performance in the agri-food industry?

(4). Mechanisms: What are the mechanisms that can be used to explain the relationships between interventions and outcomes? Under what circumstances are these mechanisms activated or not activated? For example, what mechanisms can be used to explain the relationships between knowledge mobilisation and supply chain lean performance in agri-food industry? For example, would quantitative research method such as Structural Equation Modelling (SEM) be a proper method to establish effects of knowledge mobilisation to supply

chain lean performance? To activate the proper use of SEM, the survey questionnaire for data collection needs to be above the required threshold (for example, over 200). If the sample size is below the threshold, the use of SEM should be deactivated.

Applying the CIMO logic to the context under this PhD study, the main interests in the form of CIMO logic are:

- Context: complexity and fragmentation of agri-food supply chain (C)
- Intervention: knowledge mobilisation practices and tools for lean AFSC (I)
- Mechanisms: quantitative investigation via questionnaire survey and SEM analysis of the relationships between knowledge mobilisation process of lean AFSC (M)
- Outcomes: the achievement of lean AFSC (O).

Based on the above CIMO logic, the following three review questions were formulated:

RQ1. What are the key factors affecting knowledge mobilisation in agri-food supply chains?

RQ2. How to cross knowledge boundaries (i.e. by using what boundary spanning mechanisms) in agri-food supply chains?

RQ3. What is the impact of the boundary spanning mechanisms on agri-food supply chain lean performance?

Phase two: Locating papers

After the three review questions have been formulated, the next phases of the SLR are aiming to find answers to the review questions. First of all, it needs to locate papers for the review analysis. Three means have been used to locate papers: searching databases as the main source for obtaining papers, complemented by cross-referencing and expert recommendations.

Databases

Because the main source for papers is searching for databases, choosing the right databases is

critical for this study. On the one hand, database search needs to have a good coverage without missing important relevant studies. On the other hand, the search needs to return papers with good quality standards. The choice of databases search will undoubtedly affect the quality of the results obtained. In general, two types of databases can be found. One type is non-human-curated databases, for example, Google Scholar which is a freely available to everybody who can access Google. The other type if human-curated databases, for example, most of the scientific databases included in the University of Plymouth's electronic library, Primo (https://plymouth.libguides.com/az.php). The University Library has over 170 databases including Web of Science, Elsevier, ScienceDirect, Taylor Francis, Emerald, and Springer which are all human-curated databases. Human-curated databases are selected and monitored by information specialists and relevant committees, hence are considered as having scholarly merits and meet quality criteria (Michigan State University, 2017). On the contrary, non-human-curated databases is considered as simply a search engine that have access the entire Internet, without applying to quality check and meeting scholarly standards, hence usually include a vast amount of less relevance, low-quality and even out-of-data information. This study used human-curated databases to ensure high relevance and quality of the source. The SLR also wanted to include most up-to-date articles as its literature review source. Three highly relevant databases were used in this study: Business Source Complete, Web of Science and Science Direct. A brief summary of the databases and the reason for choosing the databases is provided in Table 2.2.

Table 2.2: Information and choices for databases

Database name	Brief information	Reason for choosing the database
Business Source Complete	Main scholar database for business research. Most papers included in the Business Source Complete (via EBSCO) are full-text and others can be checked for full-text via the University Library, Primo.	This PhD project is within the business management area, hence highly relevant.
Web of Science	major research database that provides access to some of the world's top journals and conference proceedings for many different academic disciplines, including Science and Technology, Social Sciences, Arts and Humanities.	The database covers a long period of publications, with indexed and archived records go back to 1900. It has more than 8,700 high quality peer-viewed journals and provides users with complete bibliographic data from the most influential researchers.
Science Direct	Provides nearly 2,500 journals and more than 26,000 book titles on science and technology, with additional information on management, social sciences, and medicine.	The database provides full-text articles, which bis an important feature for this PhD study, because all papers to be included in SLR analysis have to be in full-text.

Apart from the search engine, all three databases provide extra functions to help refine searching results, for example, researchers can use publication years, discipline areas, article types (i.e. review articles, research articles or book chapters), publication titles or access types (open access or subscription) to filter out excessive papers. The initial searching findings can also be ordered by a number of features, for example, by relevance or date of publication. These search engines also provide "advanced search" function, which will allow the use of combination of keywords to form searching strings via operators such as "AND" and "OR".

Keywords and search strings

Keywords need to be carefully chosen for database search, because in the end it is keywords that will determine the papers to be returned from the databases. One key issue which needs special attention in defining keywords is the balance between two measures: precision and coverage. Coverage is the proportion of retrieved relevant papers among all relevant studies

(Petticrew & Roberts, 2006). If the coverage is high, it means that most relevant papers are retrieved, hence there is only a very small percentage of papers that are missed. The second measure would be precision, which is the proportion of the retrieved relevant papers among all retrieved papers. If the precision is high, it means that most retrieved papers are relevant, hence there is only a small chance that a retrieved paper is irrelevant or of low relevance (Cooper, 2015). Theoretically, it would be ideal one can achieve both high precision and high coverage. Practically, it is difficult to achieve high precision and high coverage at the same time, hence defining the right keywords would be the key to have a good balance between precision and coverage. Keywords should be sufficiently broad in order not to artificially restrict the number of returns from database search (i.e. could affect the coverage), in the meantime, keywords should be specific enough in order to bring only the studies highly relevant to the topic, that is, to have high precision The researcher had to balance precision by defining the right keywords. In this study, keywords were defined and redefined iteratively until the balance between precision and specificity was achieved. This study designed a four-level structure for keywords to capture publications related to the topic, as shown in Table 2.3. Level 1 includes keywords and their variants of “supply chain” for the research context. Level 2 includes keywords and their variants for “agriculture” and “food”. knowledge mobilisation model. Level 3 specifies keywords and their variants for “knowledge mobilisation”. Finally, Level 4 provides keywords and their variants related to “lean management”.

Table 2.3: The proposed four-level structure for keywords

Context keyword: supply chain OR supply-chain OR value chain OR value-chain OR supply network OR supply-network
AND Agriculture keywords: Agriculture OR agricultural OR agribusiness OR food supply OR food trade OR food supply chain management OR agriculture trade OR agriculture supply chain management OR agri-food chain management
AND Knowledge mobilisation keywords: Knowledge boundaries OR boundary classification OR boundary-spanning mechanisms OR knowledge sharing and flow OR knowledge brokering OR knowledge networking OR knowledge mobilization OR knowledge exchange
AND Lean key words: Lean supply chain OR lean management OR lean enterprise OR lean implementation

When the keywords at each of the four levels have been formulated, searching strings can be formed by combining the keywords from all four levels, using Boolean operators AND and OR. For example, one search string could be “supply chain” and “agricultural” and “knowledge boundary” and “lean management” OR “lean implementation”. By following the four-level structure, a range of search strings can be formed to search through the three chosen databases: Business Source Complete, Web of Science and Science Direct.

One effective way to check the refined keywords and formulated search strings is to conduct a pilot study for literature review. The pilot literature review helped the researcher not only to have confirmed that the search strings were able to return sufficient number of results from searching the three databases, but also to have further widened the keyword options by going through the topics of studies relevant to this field (such as knowledge boundary, boundary types, knowledge broker, spanners and the like).

In addition to the papers returned from searching the three databases using the defined

searching strings formed by keywords, the researcher also found some papers by tracing the references from the papers returned from database searching. This is referred to as cross-referencing by Denyer and Tranfield (2009). This study also included papers recommended by experts, mainly my own PhD supervisors, expert commentators for my RDC.1 (i.e. project approval) and RDC.2 (i.e. transfer report), and reviewers who evaluated my own publications. Through the combination of database search, cross-referencing and expert recommendations, the researcher was able to obtain a great number of papers to be taken into the next phase of SLR. In total, over 2000 papers were returned. Table 2.4 described the number of papers returned from which sources.

Table 2.4: Number of papers returned from specific sources

Source		Number of papers returned
Database search	Business Source Complete	678
	Web of Science	843
	Science Direct	466
Cross-referencing		25
Expert recommendations		17
Total		**2,029**

Phase three: Paper selection and evaluation

This phase needs to reduce the number of papers from over 2,000 to a manageable number in order to conduct any meaningful analysis. In order to do this, two sets of criteria have been defined. Firstly, a list of inclusion and exclusion criteria to clearly distinguish which papers should be included and which papers can be excluded, that is, to complete the paper selection. Secondly, to further examine the remaining papers, a list of criteria for quality assessment (i.e. for paper evaluation).

By considering the guidance from Newbert (2007) and the specific requirements of this PhD project, the author defined six pairs of inclusion and exclusion criteria for the selection of

papers to be included in the SLR, as clearly shown in Table 2.5.

Table 2.5: Inclusion/exclusion criteria for paper selection in this SLR

Criteria	Inclusion	Exclusion
Availability	Full-text papers	Parts of the original text (e.g. abstracts only, selected sections and bibliographical references)
Types of papers	• Theoretical and empirical journal articles • High quality conference papers • Technical studies with management significance	• Pure marketing purpose • Pure technical studies
Peer review	Peer-reviewed papers	Not peer-reviewed papers
Relevance	• Papers could help to answer the formulated review questions • Papers provide usable methods to develop the research • Papers offer useful data and information	• Papers miss out the review questions • Papers lack methods of high quality • Papers fail to provide useful data and information
Language	English	Not in English
Publication period	2006-2021	2005 and before

Having explicitly defined inclusion/exclusion criteria is helpful, because by applying the inclusion/exclusion criteria to the originally returned set of papers, all the papers that did not meet the inclusion criteria can were removed. For example, all papers before 2005 were firstly removed because 2006 was chosen as the widely agreed starting point for serious research on knowledge mobilisation crossing boundaries. In addition, many papers were returned from database search because they had the defined keywords in the text however the topic of knowledge mobilisation was only a secondary interest of the papers, hence were also excluded at this phase. There were papers that full-text was not available even after all efforts have been taken (i.e. only parts of papers or only abstracts were available), which had to be removed. This

situation happened mostly with papers returned from Web of Science. There were other papers which were published for marketing purposes, mainly resulted from the searching of Business Source Complete database. Furthermore, there are a significant number of papers (in fact 175) were duplicated from the three databases. This is because all three databases are comprehensive and have overlaps of the same journals. The duplicated papers were also removed from the collection. At the end of paper selection by applying inclusion and exclusion criteria, the number of papers was reduced to 237.

However, the 237 papers were only considered as a "whole piece" that passed the initial round of selection (i.e. by applying inclusion and exclusion criteria). In order to further evaluate each remaining paper, the remaining 237 papers were carefully read in detail. The researcher examined the key elements inside each paper, from theoretical foundation through research methods, data collection and analysis to contribution to new knowledge and management implications, by following clearly defined "quality assessment criteria". Table 2.7 summaries the quality assessment criteria defined for this SLR which have been applied to distinguish the quality level (low, medium or high) of specific elements of each paper. Only those papers which have "high" level of quality for all the elements (theory, methodology, data analysis, contribution and implication for management practice) were kept.

Table 2.6: Quality assessment criteria

Element	Description	Low	Medium	High
Theory	Does the paper have comprehensive review of literature to provide solid theorical foundation?	Limited literature review with weak argument	Literature review is adequate	Thorough analysis of literature
Methodology	Does the paper have a justified research design?	Methodology not justified and with obvious problems	Workable methodology but lacks justification	Methodology well-designed and justified
Data analysis	Does the paper follow a proper analysis process?	No process followed, weak connection between data and conclusions	Sample size OK, some connections between data and conclusions	Sufficient sample size, proper process, analysis findings strongly support conclusions
Contribution to new knowledge	Does the paper have significant contributions to new knowledge	None or very little	Some contribution	Significant contribution to new knowledge
Implication for management practice	Are the findings useful to management practice?	Too abstract to implement	Potential to implement	Easy to apply to practice

As the outcome of Phase three, 81 papers remained in the collection. The following Figure 2.2 illustrates how the papers were reduced step by step from over 2,000 to the final collection of 81 to be included in the analysis during the next phase of SLR.

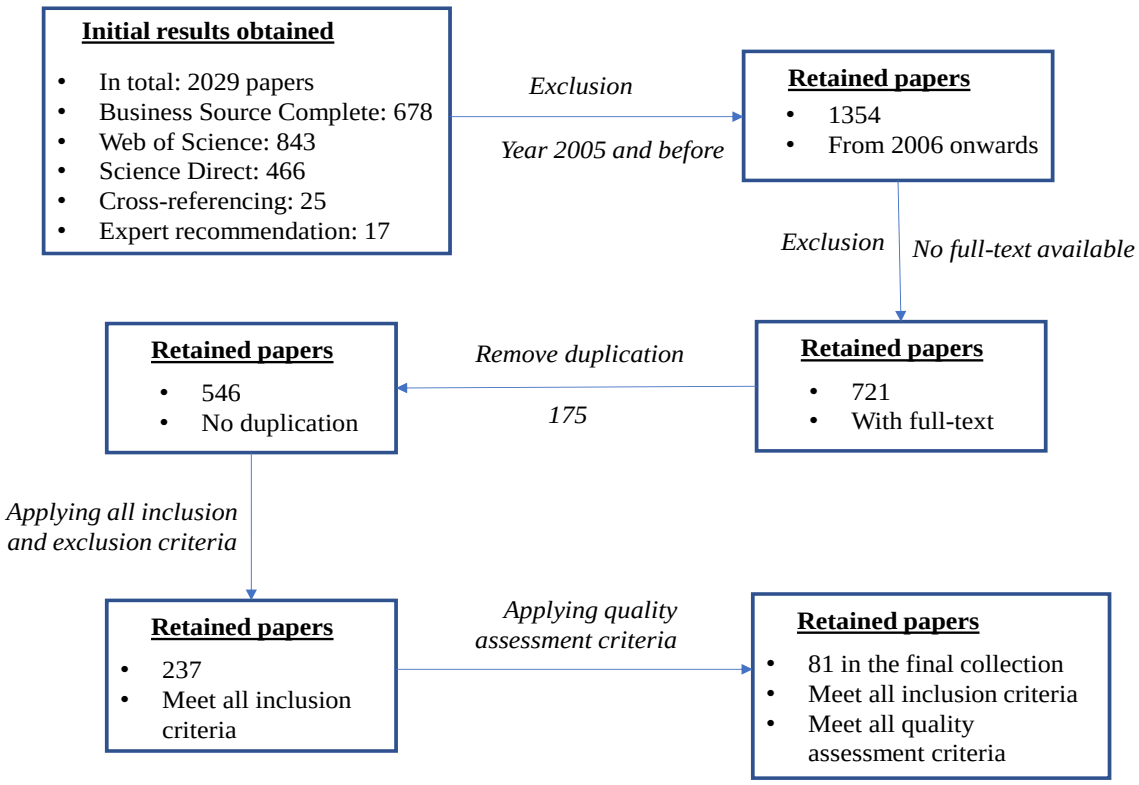


Figure 2.2: The steps the papers were reduced down

Phase four: Analysis and synthesis

After the final collection of 81 papers were obtained, the analysis of literature can start. All of the selected 81 papers were entered into Bibexcel, a software that can help to organise a large number of literature for analysis and synthesis. An overview of the 81 papers included in the final collection for SLR analysis are shown in Table 2.7. Two types of analysis were conducted in the SLR for this study: descriptive analysis and thematic analysis. To facilitate the two types of analysis, this phase of SLR used the three dimensions recommended by (Melacini, Perotti, Rasini & Tappia, 2018):

- Defining characteristics: allow the selected papers to be classified, for example, according to the year of publication, geographic distribution of authors (for clarity purpose, it is the lead author's country) and journal titles.
- Methods adopted: the research methods used in the 81 papers. Five research methods

were distinguished in line with (Seuring & Müller, 2008; Winter & Knemeyer, 2013): theoretical and conceptual papers, case studies/interviews, surveys, modelling papers, literature reviews. In the case of multiple methods are used in one single paper, then the paper was classified according to the primary research method used.

- Themes addressed: by analysing and synthesising the collected 81 papers, four common themes emerged from the literature, which will be reported in the next phase. Theme A – key factors affecting agri-food supply chains, Theme B - sustainable agri-food supply chains, Theme C – knowledge management in agri-food supply chains, and Theme D – lean performance KPIs.

Table 2.7: An overview of the 81 papers included in the SLR

No.	Lead author, Year	Country	Journal	Title of paper	Method used	Themes addressed			
						A	B	C	D
1	Chen, Liu, & Oderanti, 2020	UK	International Journal of Decision Support System Technology	A Knowledge network and mobilization framework for lean supply chain decisions in agri-food industry	Case Study/ Interview	x	x	x	x
2	Harland, 2021	Italy	Journal of Supply Chain Management	Discontinuous wefts: weaving a more interconnected supply chain management tapestry	Literature/ Systematic Review	x	x		
3	De & Singh, 2021	India	Journal of Cleaner Production	Analysis of fuzzy applications in the agri-supply chain: a literature review	Literature/ Systematic Review	x	x		
4	Amentae, Gebresenbet, & Ljungberg, 2018	Ethiopia	International Food and Agribusiness Management Review	Examining the interface between supply chain governance structure choice and supply chain performances of dairy chains in Ethiopia	Questionnaire Survey	x	x		x
5	Busse, Schleper, Weilenmann, & Wagner, 2017	Switzerland	International Journal of Physical Distribution & Logistics Management	Extending the supply chain visibility boundary: Utilizing stakeholders for identifying supply chain sustainability risks	Experimental/ Piloting	x	x		
6	Bamgboje-Ayodele, Ellis, & Turner, 2014	Australia	Proceedings of the International Conference on Intellectual Capital, Knowledge Management & Organizational Learning	Identifying key research challenges in investigating knowledge optimization strategies in perishable food chains	Literature/ Systematic Review	x	x	x	
7	Umar, Wilson, & Heyl, 2021	New Zealand	Journal of Knowledge Management	The structure of knowledge management in inter-organisational exchanges for resilient supply chains	Case Study/ Interview	x	x	x	
8	Mangla, Sharma, Patil, Yadav, & Xu, 2019	UK	Journal of Cleaner Production	Logistics and distribution challenges to managing operations for corporate sustainability: Study on leading Indian diary organizations	Case Study/ Interview	x	x		
9	Rao, 2007	India	Technological forecasting and social change	A framework for implementing information and communication technologies in agricultural development in India	Case Study /Interview	x	x		

10	Marques, Yan, & Matthews, 2020	Brazil	Journal of Supply Chain Management	Knowledge diffusion in a global supply network: a network of practice view	Case Study/ Interview	x		x	
11	Patidar & Agrawal, 2020	India	Benchmarking: An International Journal	A mathematical model formulation to design a traditional Indian agri-fresh food supply chain: a case study problem	Case Study/ Interview	x	x		
12	Schoenherr, Narasimhan, & Bandyopadhyay, 2015	USA	International Journal of Operations & Production Management	The assurance of food safety in supply chains via relational networking A social network perspective	Questionnaire/ Survey	x	x		
13	Alamar, Falagán, Aktas, & Terry, 2018	UK	Journal of the science of food and agriculture	Minimising food waste: a call for multidisciplinary research	Literature/ Systematic Review	x			x
14	Mau & Mau, 2008	Germany	Communications of the IBIMA	Requirements of knowledge management systems according to performance and risk related issues in global supply chains	Case Study/ Interview	x		x	
15	Scholten & Schilder, 2015	Netherlands	Supply Chain Management: An International Journal	The role of collaboration in supply chain resilience	Case Study/ Interview	x	x		
16	Wolfert, Verdouw, Verloop, & Beulens, 2010	Netherlands	Computers and Electronics in Agriculture	Organizing information integration in agri-food-a method based on a service-oriented architecture and living lab approach	Experimental/ Piloting	x	x	x	
17	Umar, Wilson, & Heyl, 2017	New Zealand	SAGE open	Food network resilience against natural disasters: a conceptual framework	Literature/ Systematic Review	x	x		
18	Gersch, 2019	Turkey	Geografisk Tidsskrift-Danish Journal of Geography	Foreign direct investment and local supplier upgrading – the case of grocery retail in Turkey	Case Study/ Interview	x	x		
19	Marques, 2019	Brazil	International Journal of Productivity and Performance Management	Sustainable supply network management: A systematic literature review from a knowledge perspective	Literature/ Systematic Review	x	x	x	
20	Sporleder, 2006	USA	Quantifying the Agri-food Supply Chian	Strategic alliances and networks in supply chains - Knowledge management, learning and performance measurement	Literature/ Systematic Review	x	x	x	
21	Kumar, 2014	USA	Expert Systems with Applications	A knowledge based reliability engineering approach to manage product safety and recalls	Experimental/ Piloting	x		x	
22	Ali & Gurd, 2020	Australia	Knowledge and process management	Managing operational risks through knowledge sharing in food supply chains	Quantitative Modelling	x	x	x	
23	Touboulic, McCarthy, & Matthews, 2020	UK	Journal of Supply Chain Management	Re-imagining supply chain challenges through critical engaged research	Literature/ Systematic Review	x	x		
24	Byrne & Power, 2014	Australia	Supply Chain Management: An International Journal	Exploring agency, knowledge and power in an Australian bulk cereal supply chain: a case study	Case Study/ Interview	x	x	x	
25	Sacchi, Belletti, Biancalani, Lombardi, & Stefani, 2019	Italy	Journal of Rural Studies	The valorisation of wheat production through locally-based bread chains: Experiences from Tuscany	Case Study/ Interview	x	x		
26	Serazetdinova et al., 2019	UK	Journal of the science of food and agriculture	How should we turn data into decisions in agri-food?	Case Study/ Interview	x		x	

27	Sacchi et al., 2018	Italy	Agriculture	A multi-actor literature review on alternative and sustainable food systems for the promotion of cereal biodiversity	Literature/ Systematic Review	x	x		
28	Lubell, Niles, & Hoffman, 2014	USA	Society and Natural Resources	Extension 3.0: managing agricultural knowledge systems in the network age	Questionnaire/ Survey	x	x	x	
29	De Bernardi & Tirabeni, 2018	Italy	British Food Journal	Alternative food networks: sustainable business models for anti-consumption food cultures	Case Study/ Interview	x	x		
30	Sener, Barut, Oztekin, Avcilar, & Yildirim, 2019	USA	Journal of Business Research	The role of information usage in a retail supply chain: a causal data mining and analytical modeling approach	Quantitative Modelling	x		x	
31	Dubois, 2019	Swede n	Agriculture and Human Values	Translocal practices and proximities in short quality food chains at the periphery: the case of North Swedish farmers	Case Study/ Interview	x	x		
32	Hyland, Crehan, Colantuo no, & Macken-Walsh, 2019	Hungar y	Studies in Agricultural Economics	The significance of short food supply chains: trends and bottlenecks from the skin thematic network	Case Study/ Interview	x	x		
33	Greco et al., 2020	USA	Journal of Agriculture, Food Systems, and Community Development	Farm Fresh Food Boxes: A pilot that examined relationships in value chain partnerships	Case Study/ Interview	x	x		
34	Soini, Pouta, Latvala, & Lilja, 2019	Finland	Sustainability	Agrobiodiversity products in alternative food system: case of Finnish native cattle breeds	Case Study/ Interview	x	x		
35	Roy, Hall, & Ballantin e, 2017	Canada	Journal of Destination Marketing & Management	Trust in local food networks: The role of trust among tourism stakeholders and their impacts in purchasing decisions	Case Study/ Interview	x	x		
36	De Bernardi, Bertello, & Venuti, 2019	Italy	Sustainability	Online and on-site interactions within alternative food networks: sustainability impact of knowledge-sharing practices	Quantitative Modelling	x	x	x	
37	Török, Tóth, & Balogh, 2019	Hungar y	Journal of Innovation & Knowledge	Push or Pull? The nature of innovation process in the Hungarian food SMEs	Quantitative Modelling	x	x		
38	Rocchi, Randelli, Corsini, & Giampaol o, 2020	Italy	Regional Studies	Farmer direct selling: the role of regional factors	Quantitative Modelling	x	x		
39	Lamprino poulou & Tregear, 2011	UK	Journal of Business & Industrial Marketing	Inter-firm relations in SME clusters and the link to marketing performance	Case Study/ Interview	x	x		
40	Lefebvre et al., 2014	Italy	Creativity and innovation management	SMEs' preference for innovation networks: a choice experimental approach	Experimental/ Piloting	x	x		
41	Kebebe, 2018	Ethiopi a	Technology in Society	Bridging technology adoption gaps in livestock sector in Ethiopia: a innovation system perspective	Case Study/ Interview	x	x		
42	Taylor, 2016	UK	Supply Chain Management: An International Journal	Strategic considerations in the development of lean agri-food supply chains: a case study of the UK pork sector	Case Study/ Interview	x	x		x
43	Manzouri , Ab-Rahman,	Malays ia	Sustainability	Increasing production and eliminating waste through lean tools and techniques for halal food companies	Questionnaire/S urvey	x		x	x

	Zain, & Jamsari, 2014								
44	Vlachos, 2015	UK	Production Planning & Control	Applying lean thinking in the food supply chains: a case study	Case Study/ Interview	x	x		x
45	Cox, Chicksand, & Palmer, 2007	UK	British Food Journal	Stairways to heaven or treadmills to oblivion? Creating sustainable strategies in red meat supply chains	Case Study/ Interview	x	x		
46	Pilinkienė, Gružauskas, & Navickas, 2017	Italy	Trends and Issues in Interdisciplinary Behavior and Social Science	Lean thinking and Industry 4.0 competitiveness strategy: Sustainable food supply chain in the European Union	Case Study/ Interview	x	x		x
47	Chabada, Dreyer, Romsdal, & Powell, 2012	Norway	Advances in Production Management Systems: Competitive Manufacturing for Innovative Products and Services	Sustainable food supply chains: towards a framework for waste identification	Literature/ Systematic Review	x	x		x
48	Jie & Gengatharen, 2018	Australia	Business Process Management	Australian food retail supply chain analysis	Questionnaire/ Survey	x	x		
49	Das, 2019	USA	International journal of mathematical, engineering and management sciences	Integrating lean, green, and resilience criteria in a sustainable food supply chain planning model	Quantitative Modelling	x	x		x
50	Wesana et al., 2018	Uganda	Journal of Cleaner Production	Towards nutrition sensitive agriculture: actor readiness to reduce food and nutrient losses or wastes along the dairy value chain in Uganda	Questionnaire/ Survey	x	x		x
51	Zarei, Fakhrzad, & Paghaleh, 2011	Iran	Journal of Food Engineering	Food supply chain leanness using a developed QFD model	Quantitative Modelling	x	x		x
52	Scherrer-Rathje, Boyle, & Deflorin, 2009	Switzerland	Business Horizons	Lean, take two! Reflections from the second attempt at lean implementation	Case Study/ Interview	x			x
53	Shah & Ganji, 2017	UK	British Food Journal	Lean production and supply chain innovation in baked foods supplier to improve performance	Questionnaire/ Survey	x	x		x
54	Castro & Jaimes, 2017	Colombia	Journal of industrial engineering and management	Dynamic impact of the structure of the supply chain of perishable foods on logistics performance and food security	Experimental/ Piloting	x	x		
55	Bloom & Hinrichs, 2017	US	Environment and planning	The long reach of lean retailing: Firm embeddedness and Wal-Mart's implementation of local produce sourcing in the US	Case Study/ Interview	x	x		x
56	Pearce, Dora, Wesana, & Gellynck, 2018	Belgium	Journal of Cleaner Production	Determining factors driving sustainable performance through the application of lean management practices in horticultural primary production	Case Study/ Interview	x	x		x
57	Cox & Chicksand, 2005	UK	European Management Journal	The limits of lean management thinking: multiple retailers and food and farming supply chains	Case Study/ Interview	x	x		x
58	Colgan, Adam, & Topolansky, 2013	UK	International Journal of Agricultural Management	Why try lean? a Northumbrian farm case study	Case Study/ Interview	x	x		x
59	De Steur, Wesana, Dora, Pearce, & Gellynck, 2016	Belgium	Waste Management	Applying Value Stream Mapping to reduce food losses and wastes in supply chains: a systematic review	Literature/ Systematic Review	x	x		x
60	Bezuidenhout,	New Zealan	British Food Journal	Quantifying the degree of leanness and agility at any point within a	Quantitative Modelling	x			x

	2016	d		supply chain					
61	Lyons & Ma'aram, 2014	UK	International Journal of Production Research	An examination of multi-tier supply chain strategy alignment in the food industry	Questionnaire/ Survey	x	x		
62	Al-Refaie, Al-Tahat, & Lepkova, 2020	Jordan	Technological and Economic Development of Economy	Modelling relationships between agility, lean, resilient, green practices in cold supply chains using ISM approach	Quantitative Modelling	x	x		x
63	Kolawole, Mishra, & Hussain, 2021)	Nigeria	Industrial Marketing Management	Addressing food waste and loss in the Nigerian food supply chain: Use of Lean Six Sigma and Double-Loop Learning	Case Study/ Interview	x	x		x
64	Asmae, Abdelali, Youssef, & Brahim, 2019	Morocco	LOGISTIQUA	The utility of Lean Six Sigma (LSS) in the supply chain agro- industry	Case Study/ Interview	x	x		x
65	Hicks, 2007	UK	International Journal of Information Management	Lean information management: Understanding and eliminating waste	Case Study/ Interview	x			x
66	Folinas, Aidonis, Triantafillou, & Malindretos, 2013	Greece	Lean Thinking Techniques	Exploring the greening of the food supply chain with lean thinking techniques	Literature/Systematic Review	x	x		x
67	Muraliraj, Zailani, Kuppusamy, & Santha, 2018	Malaysia	International Journal of Lean Six Sigma	Annotated methodological review of Lean Six Sigma	Literature/ Systematic Review	x			x
68	Albliwi, Antony, & halim Lim, 2015	UK	Business process management journal	A systematic review of Lean Six Sigma for the manufacturing industry	Literature/ Systematic Review	x			x
69	Pacheco, Pergher, Vaccaro, Jung, & Ten Caten, 2015	Brazil	International Journal of Lean Six Sigma	18 comparative aspects between Lean and Six Sigma Complementarity and implications	Literature/ Systematic Review	x			x
70	Lee, Garza-Reyes, Kumar, Rocha-Lona, & Mishra, 2013	South Korea	Advances in Sustainable and Competitive Manufacturing Systems	A comparative study of the implementation status of Lean Six Sigma in South Korea and the UK	Questionnaire/ Survey	x			x
71	Assarlind, Gremyr, & Bäckman, 2013	Sweden	International Journal of Quality & Reliability Management	Multi-faceted views on a Lean Six Sigma application	Case Study/ Interview	x			x
72	Algassem, 2006	UK	Diss. Brunel University London	Integration of Lean Six Sigma with Multi Agent Systems in the Food Distribution Industry in Small to Medium Enterprises (SMEs)	Case Study/ Interview	x	x		x
73	Costa, Godinho Filho, Fredendall, & Paredes, 2018	Brazil	Trends in Food Science & Technology	Lean, six sigma and lean six sigma in the food industry: A systematic T literature review	Literature/ Systematic Review	x	x		x
74	Powell, Lundeby, Chabada, &	Norway	International Journal of Lean Six Sigma	Lean Six Sigma and environmental sustainability: the case of a Norwegian dairy producer	Case Study/ Interview	x	x		x

	Dreyer, 2017								
75	Muñoz-Villamizar, Santos, Grau, & Viles, 2019	Colombia	British Food Journal	Trends and gaps for integrating lean and green management in the agri-food sector	Literature/ Systematic Review	x	x		x
76	Perez, de Castro, Simons, & Gimenez, 2010	Spain	Supply Chain Management: An International Journal	Development of lean supply chains: a case study of the Catalan pork sector	Case Study/ Interview	x	x		x
77	Cox & Chicksand, 2008	UK	Public Administration	Rethinking policy options for industry: appropriateness in policies for industry and UK farming and food	Case Study/ Interview	x	x		
78	Caicedo Solano, García Llinás, & Montoya-Torres, 2020	Colombia	Journal of the science of food and agriculture	Towards the integration of lean principles and optimization for agricultural production systems: a conceptual review proposition	Literature/ Systematic Review	x	x		x
79	Koloszár, 2018	Hungary	Management and Production Engineering Review	Opportunities of Lean Thinking in Improving the Competitiveness of the Hungarian SME Sector	Questionnaire/ Survey	x			x
80	Barth & Melin, 2018	Sweden	Journal of Cleaner Production	A Green Lean approach to global competition and climate change in the agricultural sector: a Swedish case study	Case Study/ Interview	x	x		x
81	Costa, Godinho Filho, Fredendall, & Ganga, 2020	Brazil	Food Control	The effect of Lean Six Sigma practices on food industry performance: Implications of the Sector's experience and typical characteristics	Questionnaire/ Survey	x	x		x

Phase five: Reporting the results

The last phase in the SLR is to report the analysis findings in sufficient details, so that relevant findings can be understandable and usable to readers. To increase readability, some findings will be presented in visual forms where appropriate to show patterns and trends, including pie charts, bar charts, graphs, tables and diagrams. In the next sections, findings from both descriptive analysis (defined characteristics, methods adopted and key factors affecting agri-food supply chains) and thematic analysis (i.e. three key themes) will be reported in detail.

2.3 Descriptive analysis and findings

This section presents the findings from descriptive analysis, staring from the defined characteristics (i.e. publication year, geographic distribution of lead author and the journals

which published the papers). Next the section will discuss the research methods used in the papers. Finally, this section will report the key factors affecting the agri-food agri-food supply chains.

2.3.1 Year of publication trend

Based on the data of publication year provided in Table 2.7, a two dimension chart can be created, using its horizontal axis to represent time period (i.e. the same time period used to include papers for SLR), from year 2006 to year 2021, and its vertical axis to represent the number of papers published in a particular year. The resulted graph of publication year distribution is shown as Figure 2.3. From the Fiure, it can be seen that, despite some fluctuations in the considered time interval, there is a general trend of growth in publications regarding knowledge mobilisation in the last fifteen years. A geometric growth in the number of publications can be observed especially after 2012, especially the number of publications reached its peak at 2019. The downward trend in the 2015/2016 interval is made up immediately by the significant rise in the number of publications in the 2017. It is understandable that the covid-19 break-out brough country lockdowns and travel restrictions, which significantly impacted people's mobility, hence knowledge mobilisation. That is why the number of publications is quite low in 2021. Another reason could be that when this SLR was completed, some research conducted in the year of 2021 may still not be published yet because of the time lag from research activities to publication.

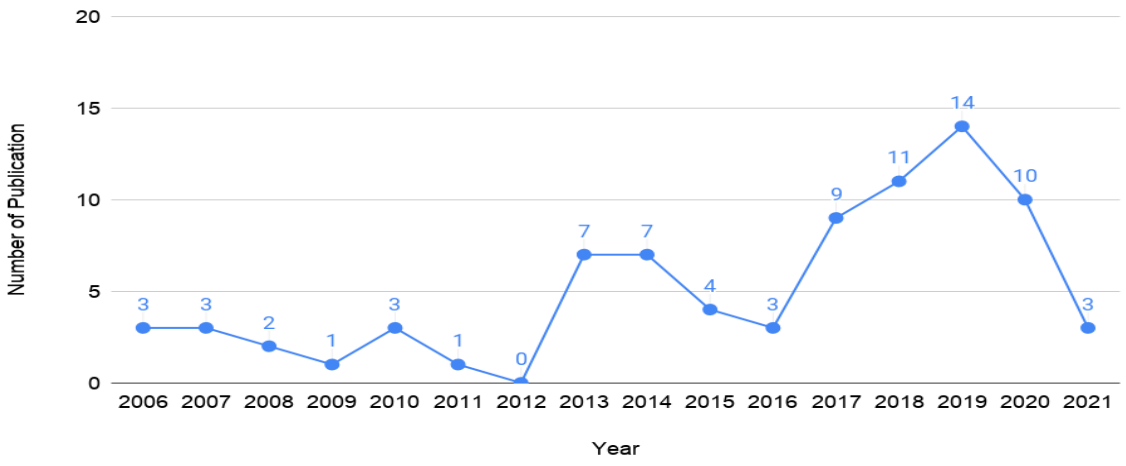


Figure 2.3: Papers distribution by year of publication

2.3.2 Geographic distribution of research

The second column in Table 2.7 provides details of the countries which the lead author belongs to. By analysing across the whole 81 papers, it can be seen that the research is distributed widely across the world. In total, the lead authors are from 28 countries. The top four countries which have no few than five papers are UK with a massive 17 papers which is almost one quarter of all the 81 papers, USA with 8 papers (i.e. about 10%), Italy also with 8 papers (i.e. also 10%) and Brazil with 5 papers (i.e. just over 6%). The analysis has further classified all 28 countries into their associated continents. In descending order of the number of papers, the activeness of the research on the topic in different continents is as follows:

- Europe (43 papers from 12 countries): Belgium (2), Finland (1), Germany (1), Greece (1), Hungary (3), Italy (8), Netherlands (2), Norway (2), Spain (1), Sweden (3), Switzerland (2) and UK (17)
- North America (10 papers from 2 countries): Canada (2), USA (8)
- South America (8 papers from 2 countries): Brazil (5) and Colombia (3)
- Asia (8 papers from 5 countries): India (3), Iran (1), Malaysia (2), South Korea (1) and Turkey (1)
- Oceania (7 papers from 2 countries): Australia (4) and new Zealand (3)

- Africa (5 papers from 5 countries): Ethiopia (2), Jordan (1), Morocco (1), Nigeria (1) and Uganda (1)

To visualise the above distribution according to continents, Figure 2.4 shows the findings in pie chart form. As the Figure clearly illustrated, Europe contributed over half of the publications to the collection of 81 included in the SLR. All other continents are active in researching the topic as well.

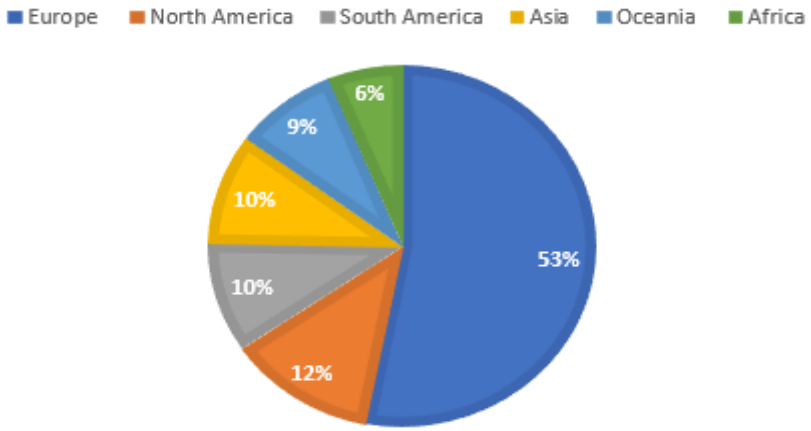


Figure 2.4: Geographic distribution of research by continent

2.3.3 Journals published the papers

The 81 papers are published on many different platforms. Table 2.7 Column "Journal" provide details of where each paper is published. It is encouraging to see that research related to the topic can be accepted so widely from business journals to agricultural journals, from supply chain journals to knowledge management journals, and from food science journals to sustainability journals. The top three journals that published most of the papers are Journal of Cleaner Production (with 5 papers), British Food Journal (with 5 papers) and Journal of Supply Chain Management (3 papers). It is worth mentioning that it is not only the number of papers these journals published, but also the high quality standards of these journals use to review the papers. It means that the research related to this PhD topic is popular and has received attention from the internationally leading publishing channels, which is very good news to the researchers.

2.3.4 Main research methods employed in literature

The research methods used in each of the 81 papers were recorded in Table 2.7. These methods can be classified into five categories as recommended by Melacini et al (2019). They are theoretical and conceptual papers, case studies/interviews, surveys, modelling papers, literature reviews. Case studies and interviews were merged because they are often used jointly in literature. The resulting classification is shown in Figure 2.5. If a paper used more than one method, then it will be classified according to the main research method used instead of the supporting method, although the maximum number of methods per paper is two for the collection of 81 papers analysed in the SLR.

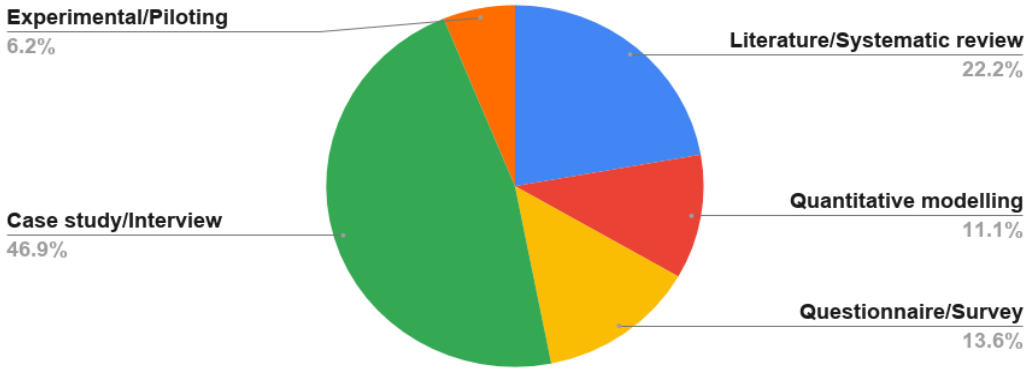


Figure 2.5: Types of research methods used in the literature

As shown in the Figure 2.5, the most widely used research method is case study/interview which is employed by almost half of the papers included in the SLR (precisely 46.9%), followed by literature review/SLR (22.2%), questionnaire survey (13.6%) and quantitative modelling (11.1%). Empirical study and piloting counts for 6.2%.

2.4 Thematic analysis

This section presents the details of thematic analysis of the 81 papers and its key findings. Firstly, key "ideas" of each paper is recorded and entered into a database. Then, the key "ideas" were synthesised, integrated or merged to form bigger pictures and links. Comparisons and

contrasts among papers in the collection were undertaken as needed. As a result, three key themes emerged from the process: (1) main factors (barriers and enablers) in sustainable agri-food supply chains, (2) knowledge management in agri-food supply chains, and (3) lean performance KPI in agri-food supply chains. Table 2.7 provides evidence of how each of the 81 papers supported the three themes (labelled as A, B and C).

2.4.1 Key factors affecting knowledge mobilisation in agri-food supply chains

To respond to the review questions, a classification of the papers based on the main factors, including key barriers and enablers, addressed was performed. Barriers can erect boundaries for knowledge mobilisation, while enablers will help knowledge to mobilise across the boundaries. The results of eleven key factors are reported in Table 2.8. It is noted that each paper resulted in one or more factors being addressed, with a maximum of five factors being addressed per paper for papers 4, 6, 31, 42, 46 52, 53 and 76.

Through the frequency analysis of the eleven factors as they appeared in the papers, the three most frequently addressed factors are collaboration, supply network structure and power, followed closely by training/education, technology, trust and commitment. The other four factors (time, cost, culture and continuous improvement) have received lest attention in literature. Among the eleven key factors, some can be considered as enablers for knowledge mobilisation, for example, collaboration, training/education, and continuous improvement. Some are considered solely as barriers, such as time, cost and culture. Other factors such as technology, supply network structure, time and commitment can have double roles, that is, if they are well set and managed, they can be an enabler, however they can also change into barriers if lack of time and commitment or without the right technology and supply network structure. Furthermore, some of the kay factors can impact on each other. For example, lack of training or education could switch technology from an enabler to a barrier. Similarly, collaboration can only be a true enabler if trust is established and commitment from partners is

evident. The complexity of the key factors has highlighted the importance of investigating knowledge mobilisation in agri-food supply chains. These identified key factors, including both barriers and enablers, will be considered when developing the conceptual knowledge mobilisation framework later in this chapter.

Table 2.8: Key factors affecting knowledge boundaries highlighted in the papers

Topic	Description	Papers
Power	1. Senior managers' involvement, interests and lead the process (Top to bottom implementation) 2. Government involvement (Government policy support)	1, 4, 5, 6, 22, 24, 25, 29, 31, 42, 44, 45, 46, 52, 53, 56, 57, 68, 70, 71, 76, 80, 81
Supply Network Structure	1. Relationship between stakeholders (personal relationship, vertical or horizontal relationship) 2. Linking between stakeholders in supply chain/community	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81
Collaboration	1. Cooperation for specific task or process. 2. information sharing and exchange between stakeholders	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67 ,68, 69, 70, 71, 72, 73, 74, 75, 76, 77 ,78, 79, 80 ,81
Technology	Take advantages of ICT to achieve specific function or improve effectiveness and efficiency	2, 4, 6, 8, 9, 11, 13, 14, 16, 21, 25, 26,28, 29, 30, 31, 36, 38, 41, 49, 62, 65
Trust	1. willingness to share knowledge and information. 2. willingness to accept suggestions, acquire knowledge and act as request.	4, 6, 10, 18, 19, 20, 24, 25, 26, 27, 30, 31, 33, 34, 35, 39, 40, 42, 46, 48, 49
Commitment	1. Agreement for specific request or requirement (confidential of information, purchasing agreement)	15, 20, 29, 40, 42, 46, 48, 50, 52, 53, 55, 78
Training/Education	The process to learn and understand specific skills, technology, knowledge and information.	7, 8, 9, 26, 27, 28, 37, 38, 41, 43, 46, 50, 52, 53, 56, 58, 63, 68, 71, 72, 73, 79, 80, 81
Time	Time for knowledge transfer, project span, technique, and approach implementation	4, 9, 21
Cost	Financial resource	9, 21, 43
Culture	Culture of organization or local	76
Continuous Improvement	Review process after implementation	76

Collaboration, trust and commitment

Previous studies confirmed that increasing collaboration is very important to improve supply chain performance: satisfying customers and increasing efficiency, (Campo, Gijsbrechts, & Nisol, 2000; Fitzsimons, 2000; Gruen & Corsten, 2007). Intense collaboration can also solve sustainability trade-offs, as no single firm can master all areas of expertise (Pagell & Wu, 2009).

One important organisational characteristic, the capacity of an organisation to absorb knowledge transfers could have furthered the understanding of the collaboration-performance relationship. Such capacity varies greatly among organisations and can be helpful in studying the collaboration-performance relationship. In fact, greater absorptive capacity helps organisations to cultivate and transform knowledge acquired in the supply chain more effectively. Hence, it can be expected that a higher degree of absorptive capacity will moderate the collaboration-performance relationship. Additionally, the value of collaboration in the supply chain comes from the possibility for inter-organisational learning. Inter-organisational learning, which entails a problem-solving routine involving supplier and/or customers is one of the resources that can be developed in the supply chain, and it can instil additional capabilities in organisations (Vachon & Klassen, 2008).

However, collaboration cannot exist in supply chain relationships without meaningful trust and commitment. Trust is a vital issue in buyer-supplier relationships, it influences both knowledge sharing and collaborative planning and especially in small firms has a moderating role in collaboration-related decisions (Brunetto & Farr-Wharton, 2007; Cai, Jun, & Yang, 2010). Overall, trust is the degree to which partners perceive each other as credible and benevolent and is expected to have a positive effect on the degree of collaboration in supply-chain relationships. In addition, commitment is characterized by long-term relationships or the willingness of each partner to exert effort on behalf of the relationship. Trust and commitment are dimensions of a business relationship that determines the degree to which each party feels

they can rely on the integrity of the promise offered by the other (Jie & Gengatharen, 2019).

Supply network structure

The general management literature offers a well-established body of research underscoring how knowledge flows across networks (Inkpen & Tsang, 2016). The body of social network theory (Borgatti & Foster, 2003) and the analytical toolset of social network analysis (Borgatti, Everett, & Johnson, 2018) offer theorisation and research method, respectively to capture aspects predominantly neglected, such as non-direct suppliers role to buying firm's sustainability and innovation (Yan, Choi, Kim, & Yang, 2015); the role of multi-tier and multilateral flows; and in particular, the specific roles of non-vertical ties, such as "horizontal" ties between competitors, which is often labelled as co-opetition (Pathak, Wu, & Johnston, 2014), and "diagonal" ties between buying firm or suppliers with non-traditional stakeholders, such as regulators, not-for-profit firms and academia (Benali & Burlat, 2012). Hence, network-level studies can encompass vertical, horizontal and diagonal links to capture the complexity of the supply networks. It is imperative to understand network-level process. Moreover, solutions to tackle sustainability may call for multiple stakeholder engagement, not only at the local level but also entire supply chains.

Power

The views of power and competition come together in considerations of dominant firms and chains, and the fundamental considerations of power and markets have an impact on policy research and development. The ability of a dominant chain to manage competition arises from the use of power to manage competition in two directions: vertical competition (achieved by supply chain management) and horizontal competition (achieved by raising rivals' costs and creating barriers to entry) (Burt & Sparks, 2003).

Dobson, Waterson and Chu (1998) (Dobson, Waterson, & Chu, 1998) focus primarily on the

use of power in a vertical context. They imply that all retailers in the sector benefit from greater power in supplier relationships and that increased average gross and net margins suggest that "retailers are increasingly able to retain the benefits of their increased bargaining power rather than passing them on to consumers". This perspective focuses on one aspect of retail competition, price, and on the issue of excess profits. However, London Economics (1997) report suggests that retailing differs from other sectors of the economy and which highlights the importance of considering horizontal competition in retailing. Any assessment of market structure and power in retailing cannot divorce the vertical use of power from the horizontal use of power. Currently, in a horizontal context, the dominant chain would be willing to incur extra operating costs and take a reduced return in the short run in the hope of long-term gains through market dominance.

Technology, training/education, time and cost

Technology has been generally seen as a key enabler for knowledge mobilisation in supply chain management. In the current digital era, technologies such as Internet of Things and Big Data have fundamentally revolutionised the way for knowledge mobilisation (Serazetdinova, 2019). Firstly, ICT technologies have provided infrastructure for knowledge mobilisation such as physical and digital knowledge networks consisting of artefacts/objects (i.e. hardware and software tools). Secondly, collaborative technologies provide effective means for knowledge mobilisation, such as discussion forums and shared knowledge repositories. Thirdly, ICT technologies are often used to integrate and orient business workflows along supply chains by mobilising information and knowledge across organisational and functional boundaries (Rocchi, 2020).

To use advanced technologies in agri-food supply chains as an enabler for knowledge mobilisation, appropriate level of training/education is usually required, even for business and supply chain professionals. Training/education will provide or accelerate the relevant

workforce's skills, knowledge and competence in handling the technologies (Kebebe, 2018). Well-trained/ educated business and supply chain professionals can take full advantage of emerging technologies to improve supply chain performance such as cost reduction and time saving. On the other hand, misuse or unable to use the technologies in the right way could cause the adverse effect or even disastrous results on the supply chains (Amentae, 2018).

Culture

Culture has been a popular topic in business management for many decades, especially organisational culture has been recognised a key factor, mostly seen as a barrier, knowledge sharing (Kassem, 2019). In the context of agri-food supply chains, the research on culture's impact on knowledge mobilisation is still not as active as it should have been. One of the possible reasons could be that some partners in supply chains may lack the desire or motivation to share knowledge beyond its own organisation's boundary (Lyu & Zhang, 2017). How to create a culture to foster knowledge mobilisation across different stages of a supply chain remains an under researched topic. If such a culture can be created and maintained supply chain wide, it can be converted from a barrier to enabler for knowledge mobilisation and peer learning.

Continuous improvement

Continuous improvement has been widely used as an approach to business operations management, for example, the well-known PDCA (Plan-Do-Check-Act) cycle is successfully implemented to demonstrate continuous improvement approach (Slack & Brandon-Jones, 2019). It is surprising that in reviewing literature for this thesis, only one paper is found to have explicitly mentioned continuous improvement in agri-food supply chain management (Perez et al, 2010). Maybe because of the diversity of partners involved in an agri-food supply chain and the complex relationships among different partners, it is not quite straight forward to actually go through cycles or iterations in knowledge mobilisation processes. This can only be flagged

as a direction for future research.

How the key factors evolved over time

The research efforts devoted to the eleven identified factors (barriers and enablers) have changed over the years (Figure 2.6). At the beginning of the considered time period (2006-2010), key factors mostly explored in the literature were technology, training/education and trust. In the second period (2011-2015), there was a growing interest in factors such as collaboration and supply network structure than those considered in the first period. In more recent years (2016-2021), the focus on some key factors such as culture, continuous improvement and cost has diminished, while the interest related to collaboration, supply network structure, technology and trust have remained or substantially increased. Figure 2.6 illustrates how the change of research interests in the eleven factors over the fifteen years.

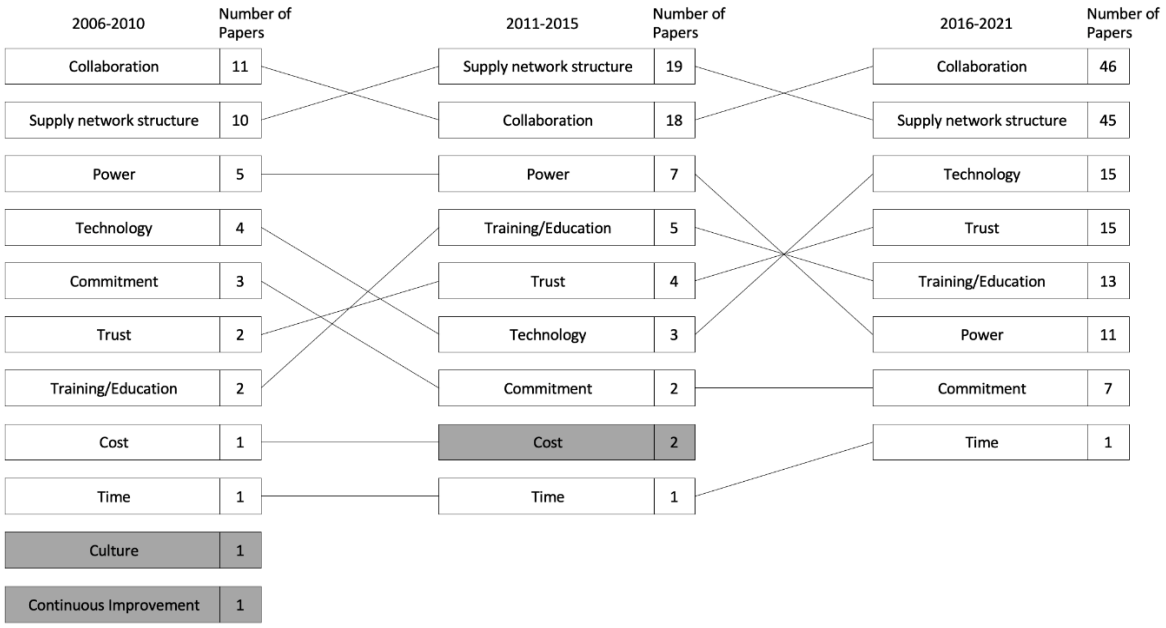


Figure 2.6: Trend of factor changes over time

Note: Grey background = the topics diminished during the studied period

Linking key factors with research methods

Table 2.9: Linking key factors with research methods used in the papers

	Literature/ Systematic review	Quantitative modelling	Questionnaire/ Survey	Case study/ Interview	Experimental/ Piloting
Power	6, 68, 73	22	4, 53, 70, 81	1, 24, 25, 29, 31, 42, 44, 45, 46, 52, 56, 57, 58, 71, 72, 76, 80	5
Supply network structure	2, 3, 6, 13, 17, 19, 20, 23, 27, 47, 59, 66, 67, 68, 69, 73, 75, 78	30, 36, 37, 49, 51, 60, 62	4, 12, 28, 43, 48, 50, 53, 61, 70, 79, 81	1, 7, 10, 11, 14, 15, 18, 24, 25, 26, 31, 32, 33, 34, 35, 39, 42, 44, 45, 46, 52, 55, 56, 57, 58, 63, 64, 71, 72, 74, 76, 77, 80	5, 16, 21, 40, 54
Collaboration	2, 3, 6, 13, 17, 19, 20, 23, 27, 47, 59, 66, 67, 68, 69, 73, 75, 78	22, 30, 36, 37, 38, 51, 60, 62	4, 12, 28, 43, 53, 61, 70, 79, 81	1, 7 ,8, 10, 11, 14, 15, 18, 24, 25, 29, 31, 32, 33, 34, 35, 41, 42, 44, 45, 46, 52, 55, 56, 57, 58, 63, 64, 65,71, 72, 74, 76, 77, 80	5, 16, 21, 40, 54
Technology	2, 6, 13	30, 36, 38, 49, 62	4, 28	8, 9, 11, 14, 25, 26, 29, 31, 41, 65	16, 21
Trust	6, 19, 20, 27	30, 49	4, 28	10, 18, 24, 25, 26, 31, 33, 34, 35, 39, 42, 46	40
Commitment	20, 78	-	48, 50, 53	15, 29, 42, 46, 52, 55	40
Training/ Education	27, 68, 73	37, 38	28, 43, 50, 53, 79, 81	7, 8, 9, 26, 41, 46, 52, 58, 63, 71, 72, 80	-
Time	-	-	4	9	21
Cost	-	-	43	9	21
Culture	-	-	-	76	-
Continuous improvement	-	-	-	76	-

Regarding the linking the research methods with the key factors investigated in each paper, the results are displayed in Table 2.9. It can be observed that the least used method is experimental or piloting. Conversely, interviews and case studies are more often used in order to assess the potential effectiveness of collaboration, to make comparisons between different network structures and to understand the views of the stakeholders involved in the decision-making process. Questionnaires and surveys, however, are adopted to a lesser extent compared to the interviews and case studies but still accounts for a large proportion. These findings reveal potential areas for the application of surveys to extend and generalise findings resulting from the interviews and quantitative models. Even more cases of reviews were found, and they are mainly review of literature and are, for the most part, related to the supply network structure and collaboration. These findings support the contribution of this study by providing a solid foundation of knowledge sharing across the boundaries in agri-food supply chains, because this analysis finds evidence of literature reviews with a broad and longitudinal perspective of knowledge transfer and sharing. In Table 2.9, the numbers refer to specific papers included in the SLR as listed in Table 2.7.

2.4.2 Sustainable supply chain management in agri-food industry

Supply chain management emerged as a distinctive subject area from operations management in the early 1980s (Cousins, Lawson, & Squire, 2006; Croom, Romano, & Giannakis, 2000). It grew out of the development of logistics, in response to ever increasing complexities of supply-based processes and the need to co-ordinate inter-firm logistic activities. However, supply chain management is considered to be a wider concept than just that of logistics-based activities. It was re-conceptualised during the early 1990s as the integration of key business processes, in addition to that of logistics processes (Lambert & Cooper, 2000):

Sustainable supply chain management (SSCM) has been the topic of high interest of researchers in the past two decades (Genovese et al., 2017; Panigrahi, Bahinipati & Jain, 2019).

Supply chains have to address the sustainability concerns by tackling environmental, social and economic issues in all core functions of the SC, from raw materials, purchasing, manufacturing, distributing, storing, warehousing, usage, recycling to disposal of the used products. A wide range of sustainability solutions, practice and measures have been proposed in literature which can be classified from the three perspectives (Saeed, Waseek & Kersten, 2017; Panigrahi, Bahinipati & Jain, 2019; Nematollahi & Tajbakhsh, 2020), for example:

- Environmental perspective: green packing, distribution, warehousing and transportation; conservation, GHG emission and carbon footprint reduction; green design and life cycle concept; reuse and recycle; environmental standards (ISO14000, ISO14001); green procurement strategies; eco-friendly technologies; reverse logistics; environmental management systems; product stewardship; and information sharing.
- Social perspective: code of conduct; employee rights, welfare and working condition; equity; public awareness and ethics; corporate social responsibility; supplier support and fair trade.
- Economic perspective: financial performance and competitive advantage; incentives, low interest loans; quick payback periods; business transparency; logistics optimisation; strategic collaboration and information sharing; efficient resource utilisation; profitability.

In order to guide supply chains to achieve sustainability, some literature has devised governance mechanisms, The top three mentioned governance mechanisms are governance structures, collaboration and formalisation, and knowledge sharing (Panigrahi, Bahinipati & Jain, 2019; Nematollahi & Tajbakhsh, 2020).

Specific to agri-food supply chains, sustainability is very relevant for example taking measures to reduce food waste has been a hot topic in recent years. A great number of publications have investigated some of the key issues related to sustainable agri-food supply chains, from

technology support (Zhao et al, 2019) to circular economy driven approaches (Sharma et al, 2019), from knowledge governance (Zhao et al, 2021) to institutional factors (Lu et al, 2020), from environmental pollution (Elgueta et al, 2020) to social fairness (Alvarez et al, 2021), from risk analysis (Zhao et al, 2020) to resilience (Stone & Rahimifard, 2018).

In order to effectively understand and manage agri-food supply chains, it is necessary to connect and group individual organisations involved in the production and delivery of food products and services into supply chains. There have been many different types of connecting and integrating agri-food supply chain players covering from governance structure to social network perspective (Schoenhe et al, 2015; Amentae, 2018; Harland, 2021). Most of these recent developments can be traced back to one of the earliest frameworks proposed by Lambert and Cooper (2000) for supply chain management, as illustrated in Figure 2.8 which consists of three main constructs. It was believed that successful supply chain management need to have a solid "supply chain network structure", a robust "supply chain business process" and an effective "supply chain management component". The combination of a strong network, a business process and management component together can ensure a success supply chain.

Firstly, "Supply Chain Network Structure" is about how to position key businesses (dominant, primary ones and other partners in a relatively weak position) in a network. The "Supply Chain Network Structure" even though are external to all organisations involved a supply chain, but are crucial to their strategic decisions in terms of how to contribute their strengths and competence to the whole chain. For example, a tomato producer knows where to deliver their vegetables to and in what transportation means, for example, via a third-party logistics or an "co-operatives" initiative. The tomato farm will also need to identify its own key suppliers for packaging materials and technology support etc. If the demand for tomatoes from the market and consumers increase or decrease, how can they respond to minimise the uncertainty (Oan et al, 2022). Of course, ideally all supply chain players can have and maintain stable

relationships with others in the network, sometimes it is inevitable that supply chain networks need to be reconfigured, hence a good level of structure flexibility is needed, especially in agri-food industry where they are many unpredictable risks (Zhao et al, 2021). For example, when Covid-19 struck and the international logistics were thrown in chaotic, most supply chains players had to rethink and react fast, by either disconnecting from its existing structure and adapting into a new structure to survive (Umar, 2017; Mangala et al, 2019).

Secondly, the "Supply Chain Business Process" is referred to as string of activities done by the supply chain members sequentially or in parallel in order to create and deliver specific products and services that add value to end consumers (Greco, 2020). A successful agri-food supply chain should have smooth flow of operations to enable smooth flow of materials and products. For example, in the case of a tomato supply chain, fresh tomatoes produced on a farm have to be transported and delivered to the next stage of the chain without much delay, otherwise the quality and shelf-life of those tomatoes can be severely damaged. It is very similar situation for most vegetable, meat and dairy product chains (Bernardi, 2018; Dubois et al, 2019). To allow a smooth business process across the whole supply chain, sometimes it is extremely important to integrate activities facilitated by information and knowledge sharing from all supply chain players (Wolfert, 2010; Sener, 2019; Serazetdinova, 2019). There is no doubt that emerging technologies such as Agriculture 4.0 and Artificial Technologies can be used to smooth business process (Pilinkiene, 2017; Olan et al, 2022). To be synchronised into the "Supply Chain Business Process", it is advised that each supply chain player can predetermine which process is relevant to their unique skills and that of their supplier members, so that they can demonstrate their competitive advantage to best contribute to the supply chain level business process (Bui et al, 2021).

Finally, "Supply Chain Management Component" aims to integrate and manage the processes across the entire supply chain, which involves managing both internal and external supply

chain networks. In agri-food supply chains, the management component not only requires skills for co-operations, collaboration and coordination, but also skills for negotiation and compromise (Marques, 2019). Increasing supply chain visibility has been seen as a helpful way to improve supply chain management (Busse, 2017).

The three constructs of a supply chain, that is, the network structure, the business process and the management component, have to be considered in a holistic manner. Any one of the three constructs does not function well, the whole supply chain will fail for sure (Umar, 2021). In general, the main responsibility of the "Supply Chain Network Structure" is to unite the internal and external nodes (i.e. the supply chain players) of the whole supply chain, which can be seen as the glue to stick together all of the supply chain partners and instruct them into the right position to ensure that the whole chain is strong and resilient (Nematollahi & Tajbakhsh, 2020). As soon as supply chain players are slotted in the big "jigsaw" of the whole supply chain, their actual interactions and collaborations will be materialised via the "Supply Chain Business Process" construct. The business process provides dynamics and coordination guidance so that all supply chain players know what to do, when to act and how to interact with up-stream and down-stream members, and what approach (i.e. push or pull) would be provide the rhythm and pace to their activities (Torok, 2018). The "Supply Chain Management Component" manages the business process along the network structure to ensure smooth flow of products, information, knowledge and service from the origin to the end of the supply chain. The scope of the management component can be very wide including all aspects of management, from operations management to strategic management, from product management to knowledge management (Kumar, 2014), from sustainability management (Bernardi, 2019) to lean management (Pearce, 2018).

This PhD is concerned with agri-food supply chains, the researcher studied existing relevant theory about general supply chain management and extended them to develop a closed loop,

sustainable agri-food value chain model, which has been published in the researcher's earlier paper (Chen et al, 2018). This agri-food supply chain model is illustrated in Figure 2.7.

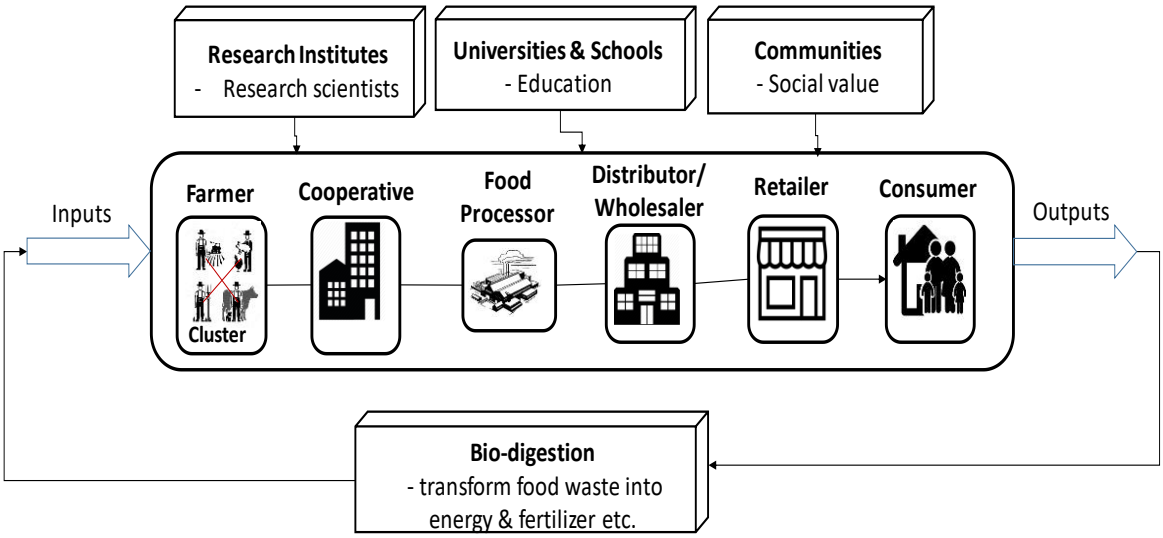


Figure 2.7: A closed loop, sustainable agri-food supply chain (Chen et al, 2018)

From the Figure, the agri-food supply chain can be seen as a transformation system "from farm to fork", which takes in inputs such as seeds, fertilizers, energy and water, and produce desired products and services that can be used by consumers (Zhao et al, 2020). During the transformation process, on the vertical dimension a series of actors slotted in the "Supply Chain Network Structure" (farmers, co-operatives, food processors, distributors/ wholesalers, retailers and consumers) all undertake specific activities contributing to the "business process" and add value. On the horizontal direction, there can be clusters of farmers work collaboratively or share knowledge as needed in order to solve a particular problem, improve efficiency or reduce cost. On the peripheral, there are more actors who contribute to the chain activities (Zhao et al, 2021). These include research institutes conducting high quality research which could result in innovations to the sector, for example, by providing new breeding or new methods to control pests. Universities and schools are the key actors to provide education to young people and children who can be the leaders for future agri-business and pioneers for changing the supply chain structure, business process and management approaches, for

example, green consumption behaviour (Mangala et al, 2019). These days, there is increasing emphasis on social value that can be supported through agri-business, for example creating community farms where families and friends can enjoy a day on a farm and learn about farming as well. Along with the campaign on sustainability and empowered by technology development, it is now possible to transform food waste, as part of the outputs from the production chain, into energy and fertilisers which can be further used as inputs to the transformation system. This type of bio-digestion technology allows the agri-food supply chain to be a sustainable, closed loop long term (Liu et al., 2019).

2.4.3 Knowledge mobilisation in agri-food supply chains

Knowledge has long been recognised as a valuable business assets as advocated by the well-known phrase "knowledge-based view (KBV)". KBV emphasises that an organisation's competitive advantage is determined by its knowledge rather than physical resources or facilities (Jayawickrama, 2015). This is because the physical resources and facilities (such as a big agricultural machinery such as a tractor or a greenhouse) in one farm can be easily replicated in other farms, however intangible knowledge of an organisation, for example, intangible knowledge such as expertise based on many years of experience of a farmer planting organic tomatoes under specific weather conditions is much more difficult for other farmers to replicate without help from extensive knowledge sharing activities. To highlight the importance of knowledge and creation of ideas, the term "knowledge worker" was widely used in literature, which brings sharp contrast to the term "manual worker" (Brinkley, 2006; Chen, Chen & Wu, 2012). It is generally believed that the term "knowledge worker" was first coined by Professor Peter Drucker, regarded by many as the "founder of modern management". In fact, Professor Drucker was one of the most influential and best-known scholars on the subject of knowledge management. Back in 1959, in his famous book "The Landmarks of Tomorrow", Professor Drucker stated that knowledge workers were high-level workers who applied theoretical and

analytical knowledge. After over 60 years, the phrase “knowledge worker” is still in wide use. Another popular term related to knowledge management is “knowledge economy” which came to use in middle of 2000s (Liu, 2020). If “knowledge worker” highlighted the importance of knowledge at individual level and “knowledge-based view” at organisational level, then “knowledge economy” has lifted the importance of knowledge to a whole new level, that is to the national or regional level, which basically means that an economy is driven by intangible knowledge rather than physical capital, natural resource or low skilled labour (Liu, 2020).

Along with the importance of knowledge at individual, organisation and nation level being recognised, knowledge management as a subject area has been popularised. A decades ago, knowledge management was mainly offered as a course to students in Computer Science. The training could be focusing on information systems, knowledge management systems, expert systems and decision systems, all of which pay great attention to manage explicit knowledge by using ICT technologies. However, today knowledge management course is also widely taught in business schools and management schools. This change reflected the fact that knowledge management is not seen from a technology perspective, but also from people and business perspectives (Dalkir, 2017). This is because knowledge management needs to help business to achieve better performance, and that it is people (and the tacit knowledge residing in them) who are at the centre of knowledge management, from knowledge creation, holding, mobilisation to use and reuse (Jayawickrama, 2015).

The field of knowledge management (KM) and knowledge mobilisation (KMob) is in a period of growth and development. To differentiate from KM and KMob, KM has developed a stronger emphasis on technology led by information systems specialists, however, KMob emphasizes complexity, emergence and the social relationships found in networks (Levin, 2008). As Davenport and Prusak (1997) said, KM and KMob are grounded in theories of social construction and based on the premise that knowledge is the human creation, that is, knowledge

usually entails a knower. Without a knower, it will never be managing information and knowledge successfully. Thus, they have a social life characteristic. This is the overlap between them. Second, KM is defined as a systematic management approach for optimizing the effective application of intellectual capital to achieve organizational objectives (Bennet & Bennet, 2004; O'Dell, 2000). Its focus is largely tied to organizational mission needs. Intellectual capital covers human capital, social capital and organizational capital: *human capital* is made up of individual's knowledge. Each person carries a unique set of characteristics and values including expertise, education and experience that can quickly respond to emerging challenges; *social capital* includes the number of interactions between individuals in a relationship network, and the length, the depth and the frequency of those interactions; *organizational capital* includes all the content in database and information that has been made explicit (Roos & Von Krogh, 2016; Stonier, 2012). However, KMob is focused on new knowledge that has emerged (and is in the process of emerging). This introduces a different in perspective, with KM being a broad field that is intended to improve organizational performance through the effective creation and management of the human, social and organizational capital, and KMob being a process for moving specific knowledge to action to value (Bennet et al., 2007). Therefore, KMob can be understood as the complex process of making new knowledge ready for service or action to build value (Brown & Duguid, 2017; Levesque & Works, 2010).

In the context of supply chains, knowledge management has faced new challenges that were not present as serious issues, especially in terms of knowledge sharing and flow through supply networks to facilitate supply level business process (Liu, Moizer, Megicks, Kasturiratne, & Jayawickrama, 2013). This mainly because many of the key factors identified in Section 2.4.1 (such as trust, time and cost) have proven to likely create barriers to knowledge mobilisation activities. Specific to agri-food supply chains, the same challenges remain. Figure 2.8

illustrates potential barriers that can be created in a simplified agri-food supply chain, which only incudes four stages: farming, food processing, distributing and retailing. The purpose of this Figure is to explain where potential boundaries exist. Compared with other industries such as automotive and electronics, agriculture is a sector that is possibly least automated or standardised because of the high variety of work done at much smaller scale. One consequence of this feature would be the increasing difficulty to knowledge management (Chen, Liu & Oderanti, 2018; Boshkaska, Liu & Chen, 2018). It is likely that majority of knowledge is context specific, embedded in workers' daily practice and it needs significant effort to develop a particular area of knowledge.

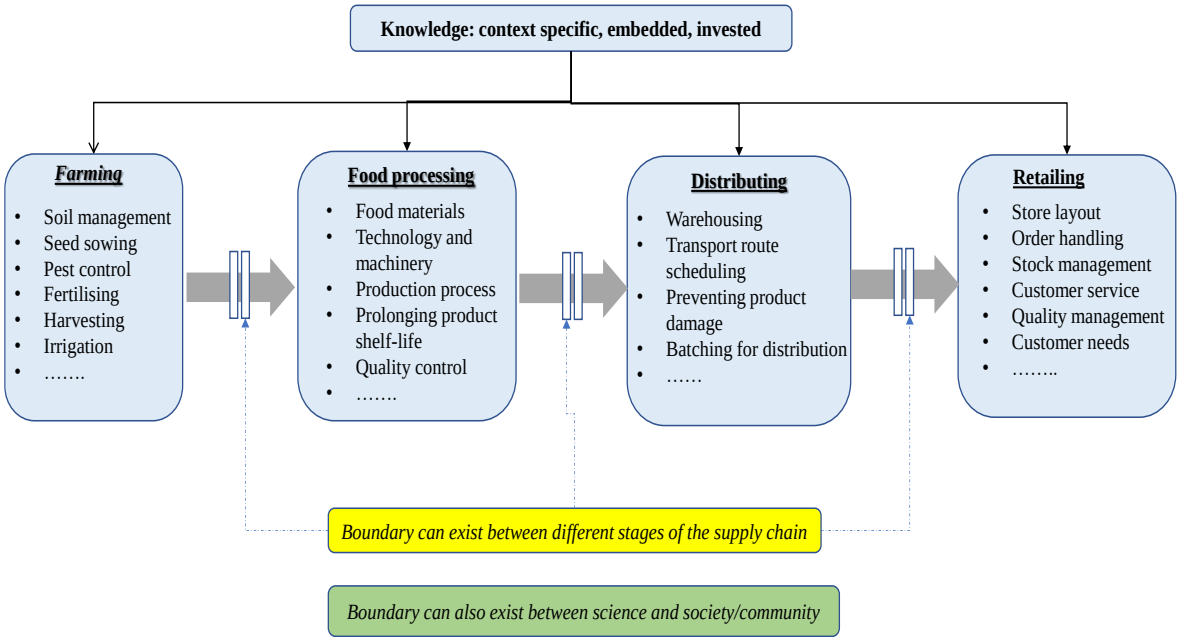


Figure 2.8: Examples of potential boundaries in an agri-food supply chain

Firstly, at the farming stage of the supply chain, important knowledge required and exercised by farmers include knowledge about soil management, knowledge about seed sowing, pest control, use of fertilisers, harvesting and irrigation etc. However, at the food processing stage, the knowledge required and practised is very different from the farming stage. Knowledge

important to food processors can be knowledge about food materials, knowledge about technology and machinery, production process, how to prolong food shelf-life and quality control. While at the distributing stage, important knowledge is different again to the farming or food processing stage. For distribution, workers need to have knowledge about warehousing food products and produces, knowledge about transport routh scheduling, preventing product damage during transport and batching for distribution. Finally, at the retailing stage, example knowledge required include store layout, knowledge about order handling, stock management, customer service and customer needs. By looking across the knowledge at the four different stages, there is hardly any overlap between the knowledge at any two stages. This means that knowledge boundary is a clear barrier between the different stages of the supply chain. However, many issues related to food such as food quality and safety, and food shelf-life can only be adequately addressed if the knowledge boundaries can be crossed successfully along whole supply chain (Mau, 2008; Marques, 2020).

If this simplified food chain is extended to full scale, that is, to include other players as shown in Figure 2.7 in Section 2.4.2, boundary can also exist between science (for example, universities and research institutes which conduct advanced experiments to create new breeds of crops and investigate new treatment for crop disease) and the farming community (i.e. who are the users of the new crop breeds and new treatment for crop disease). To enable the users of scientific findings to take full advantage, the knowledge boundaries have to be overcome (Outahar, Nfaoui, & El Beqqali, 2013; Zha et al, 2021).

Knowledge boundaries can be defined as differences in knowledge that can be resulted from many factors such as the background or education difference between a farmer and a research scientist. It can also be the different between social status or cultural values (Boshkoska et al, 2019). Recognising and understanding of knowledge boundaries is the first step to solve the problem. The concept of knowledge boundary is not new to agri-food supply chains. In fact, in

social network analysis, then evolved to knowledge networks, researchers have identified network holes, spaces and missing ties that create gaps to prevent or stop knowledge sharing (Marques, 2020).

In order to overcome knowledge boundaries, researchers have classified boundaries into appropriate categories. Most scholars have agreed to classify knowledge boundaries in three categories, namely syntactic boundary, semantic boundary and pragmatic boundary (Carlile, 2004; Jashapara, 2011; Boshkaska, Liu & Chen, 2018). Syntactic boundary is the most basic category, which means people use different languages, technical terms and vocabularies. For example, research scientists and farmers may use very different languages to refer to similar or even the same things. That is why sometimes scholars cannot communicate with farming community very effectively (Bernardi, 2019). Semantic boundary occurs sometimes when people use the same set of technical terms and vocabularies but have different interpretation of the meanings of the technical terms or languages, hence still have problems to share knowledge. For example, it is often the case people at different stages of the agri-food supply chain have different interpretation of the food quality standards, attitudes to meat consumption or impact of nutrition on health, simply because people come from different social circles and how much wealth they have (Soini, 2019). Finally, pragmatic boundary is also referred to as political boundary. This is because usually people take different interests or have different preferences in the same things. One good example is green marketing and green consumption. There usually is a lot of politics involved. Some people would believe in green consumption and spend a significant more money to buy the so-called green products, however sometimes it is found out that some farmers or supermarkets only use green marketing as a chance to increase the price of products while the products are not really organic or green. Categorizing knowledge boundaries into a small number of groups, it helps people to tackle the boundaries and learn from knowledge mobilisation practice (Zhao et al, 2020b). A fourth type of

knowledge boundary was added by Jashapara (2011) in his send edition of the book which is termed integrative boundary. It means that sometimes more than one type of boundary co-exist at the same time.

To summarise, out of the 81 papers included in the SLR, only sixteen papers discussed knowledge mobilisation in agri-food supply chains, that is, less than 20% of the papers which indicates that the knowledge mobilisation in agri-food is still an under researched topic. Collectively, the sixteen papers have highlighted five key points:

(1) It needs better understanding of the knowledge mobilisation requirements in agri-food supply chain context (Mau, 2008; Marques, 2019).

(2) It should take a strategic view by building close alliance among supply chain partners for better knowledge mobilisation (Sporleder, 2006).

(3) It needs carefully design knowledge structure and networks to enable smooth flow of knowledge from one stage of the supply chain to other stages (Lubell, 2014; Chen, 2017; Umar, 2021).

(4) A range of technologies should be used in facilitating knowledge mobilisation in agri-food supply chains (Kumar, 2014; Manzouri, 2014), from ICT technologies (Rao, 2006), big data (Serazetdinova, 2019), data mining (Sener, 2019) to agriculture 4.0 (Pilinkiene, 2017).

(5) Great effort should be invested in integration of information, diffusion of knowledge and interacting with other actors (Wolfert, 2010; Byrne, 2014; Marques, 2020).

2.4.4 Lean in agri-food supply chains

It is widely agreed that the concept of “lean” originated from Japan, thanks to the industrial engineer and businessman, Taiichi Ohno. After World War II, Japan as a whole country went into severe economic depression. Scholars and practitioners were in search for approaches to

reviving the economy, especially to increasing work efficiency and reducing cost. As a young engineer in the Toyota Motor Company, Ohno devised practice of avoiding "waste" on the factory shop-floor which later became known as the Toyota Production System (TPS) (Shah & Ward, 2007). The initial purpose of Ohno's innovation of the Toyota's management approach was for the company's survival, as many other companies in manufacturing in Japan at that time were struggling to make ends meet, let alone making any profit. Ohno was vey clear about his strategy, which is to eliminate all types of "waste" to reduce cost. It means that the company should only produce the needed units of parts, components, sub-assemblies and final products at the time of absolute need. This simple message is powerful in practical sense, because it means that there should be no unnecessary inventory of materials, parts, components, sub-assemblies and final assemblies. Toyota cars are complex and expensive products at the time in terms of its structure and production lines. There could have been millions of pounds worth of materials, parts, components, sub-assemblies and final products held by inventories, let alone all the facilities and resources needed to look after the storages. Furthermore, what if any products held in inventory were not able to sell later (because customers' needs could change over time), then these products in inventory would become waste because of over-production (Womack & Jones, 1997). There is no guarantee that any materials, parts, components, sub-assemblies or final products could not be damaged while in storage. If accidents such as fire, flood or erosion happen, the loss from holding inventory at such a massive scale as in Toyota would be severe. Ohno's suggestion to eliminate waste and reduce cost was quickly implemented across the Toyota Motor Company (Womack & Jones, 1997; Slack & Brandon-Jones, 2019).

To help fellow colleagues in the company to implement the waste reduction movement, Ohno explicitly defined waste by using the Japanese word "Muda" (which means waste and futility) (Ohno, 1988). He identified seven types of "Muda":

- Over-production: produce more products than the market needs or more products that than can be sold;
- Unnecessary transport: this mainly refers to internal transport, that is, moving materials, unfinished products or final products within a factory, is a type of waste because it will not increase the price of products
- Waiting time: because cars are complex products and their manufacturing can involve hundreds or even thousands of individual operations. Many activities cannot happen until their predecessors have successfully completed. Any activities that are not in synchronisation could create waiting times for their successors in the production lines. No matter how many days or weeks a worker is witing for materials, parts or components to arrive in order to undertake their operations, it is a type of waste.
- Excessive motion: workers may look busy for example, by running around the factory shop-floor but not actually adding any value to the final products, hence is a type of waste. This happens often because of bad layout of work space or production systems. For example, because of the operations layout design flaw, workers may not be able to reach their workpieces or tools conveniently, hence need to run a long way to get them, which clearly is creating unnecessary motions. This can also happen when sometimes machines seem to be running but not actually producing anything.
- Unnecessary processes: this type of wate is often resulted from product design flaw. Sometimes product designers do not have sufficient knowledge of product manufacturing or process planning, they could create some product features that will require extra manufacturing processes, however those features are useless in customers' eyes.
- Defective products: production lines such as TPS undoubtedly have strict quality check and control process, however it is inevitable defective products cannot be completely

avoided. Any defective products will hold certain amount of cost depending how early in the production system the defective products are determined. If quality issues related to raw material, parts, components or subassemblies can be detected early in the production system, which can be rectified relatively easily hence the cost and damage would be less severe. If quality issues were only detected at the last stage of the production system when the final product is assembled, the cost could be much greater. Producing defective products would still have used materials, workers, machines and other resources, let alone more cost would be added when extra effort to be put into reworking or worse, product recall in which case more cost would have incurred from logistics, distribution and retailing.

Ohno's identification of the seven types of Muda greatly helped fellow workers in Toyota Motor Company to master the elimination of waste and reduce cost. The effect was apparent and quickly was known in the industry. To mark this important innovation in management, the concept of "lean manufacturing" and "lean production" was fast popularised across Japanese manufacturing, notably by Womack in his influential book "The Machine that Changed the World" (Womack & Jones, 1997). The concepts of "lean manufacturing" and "lean production" further highlighted the core principle of "value". In this context, value is being seen from the customers' perspective, it means that if anything has value, then customers should be willing to pay for it. Subsequently, lean theory used terms such as "value-adding" or "non-value-adding" to measure whether an activity or resource is a type of waste or not. In other words, if an activity or use of a piece of resource is worth paying for in customers' eyes, then it is "value-adding", otherwise it is "non-value-adding", hence would be a source of waste and should be eliminated from the production process (Shah & Ward, 2007). The lean concept was soon adopted by managers beyond the manufacturing industry, and "lean management" became a stand-alone approach to guide management practice. For example, in service sector, lean management has

become wide practice in healthcare and hospitals, as well in banking and education (Mohan & Sharma, 2003; Dahlgaard-Park & Pettersen, 2009; Sezen & Erdogan, 2009; Garcia-Buendia, Moyano-Fuentes & Maqueira-Marín, 2021).

When researchers and practitioners tried to extend the lean approach to supply chain management, a preference was made to not give a definition but to opt for an extensive description. Because of the complexity of supply chains and massive differences among different types of supply chains, it is impossible to have one definition to fits all. However, providing extensive description of lean would still help the management to implement the core principles of lean and offer guidance to supply chain players. Usually it is easier and simpler to describe a journey, for example, for lean approach rather than to give a strict definition. Describing a journey would actually be more useful to practitioners to help reach the destination. Lean concept was built up from factory floor's practice, hence it makes sense lean management in supply chains should keep the essence of its practical value. When describing the journey for lean supply chain management, benefits and attributes of its end results can be explained in detail and easily understood by top managers in businesses, hence it is not surprising that lean management has been adopted as a supply chain management strategy (Ugochukwu, 2012).

Another key task that needed urgent attention in integrating lean approach to supply chain management was to examine the level of feasibility of adopting the types of waste defined in lean manufacturing, and to assess whether the seven types of waste could be directly "borrowed" and applied to supply chain practice (Arif-Uz-Zaman and Nazmul Ahsan, 2014). After a series of investigation, researchers came to the conclusion that the original definitions of the seven types of waste by Ohno was initiated in factory shop-floors within one single organisation, namely, Toyota Motor Company. The definitions of the seven types of waste need to be extended, modified, customised or refined to suit supply chain context. A lean supply chain

management model was proposed and validated by Liu et al (2013) with revised definition for the seven types of waste at supply chain level, as described in Table 2.10.

Table 2.10: Definitions of the seven types of waste at supply chain level (Liu et al, 2013)

Waste categories	Definition at supply chain level
Overproduction	Producing too much or too soon required by the downstream operations in the supply chain
Defect	Products provided by suppliers/upstream operations have quality problems or poor delivery performance
Inventory	Surplus storage between up-stream and down-stream operations in the supply chain
Over-processing	The use of a large expensive machine by the downstream operations leads to pressure to run the machine as much as possible rather than only when needed
Transportation	Delivering products among supply chain actors with delay
Waiting	Long lead-time or cycle time for products from upstream operations/suppliers
Motion	Poor workplace organization resulting in poor ergonomics in the supply chain

The implementation of lean management in agri-food supply chains took place much later than other sectors. There were very limited literatures available to present systematic study or frameworks that were developed from the agriculture sector to guide lean practice. However, some classic management models, even though they were not explicitly branded as "lean management" but in fact contributed to reducing waste. For example, Vendor Managed Inventory (VMI), Efficient Consumer Response (ECR) and Collaborative Planning, Forecasting and Replenishment (CPFR) all have been successfully implemented in practice for decades to help reduce inventory and smooth ordering systems (Barratt & Oliveira, 2001; Jones & Clarke, 2002). One common criticism on these initiatives is that they are very much focused on the downstream side of the supply chain, using the information from downstream supply chain members, as internal customers, to manage the inventory and orders. There has been a lack of focus on the upstream of the supply chains (van Donk, 2000; Olan et al, 2022). Another learning point from VMI, ECR and CPFR is that despite the effort from addressing the key

factors identified in Section 2.4.1 such as supply chain collaboration and commitment, most often in reality supply chain members solely focused on improving their own systems and have little impact on their collaborative partners in the chain. It has also been observed from practice that mechanisms such as VMI, ECR and CPFR were mainly implemented within large sized retailers and manufacturers. Many other organisations such as SMEs in the agri-food supply chains were almost not affected by the classic initiatives. This is an indicator for investigating new lean management approaches that can suit more supply chain players in the agri-food industry, and the trend has already begun.

This is evidenced by the collection of papers included in the SLR in this study. As can be seen from Table 2.7, the last column provides evidence of literature to "Theme D – lean in agri-food supply chains". Among the 81 papers included in the SLR, 37 papers are related to lean supply chain management in agri-food. It is an impressive 45.7% which indicates that lean management has now become a popular topic in agri-food supply chains. However, when taking a more detailed look into the 37 papers, only 4 papers were published before Year 2010 (Algassem, 2006; Cox, 2007; Hicks, 2007; Scherrer-Rathje, 2009), 10 papers were published over the six year period between 2010 and 2015 (Chabada, 2013; Folianas, 2013; Manzouri, 2014;), and the remaining 23 papers were all published over the last six years from 2016 to 2021 (Chen, 2017; Barth, 2018; Costa, 2020; Solano, 2020; Kolawale, 2021). This shows a clear trend of increasing interests from researchers on the topic in recent years.

Literature has provided up to date insights into possible sources for the seven types of waste defined in (Liu et al, 2013). Possible sources for waste can be individual processes undertaken within one supply chain member or from the relationships between different processes, that is, the linkage between different supply chain members. Firstly, over-production waste and over-processing waste are mostly resulted from individual activities, operations, or processes within individual supply chain members (Hick, 2007). For example, a farmer may produce more

tomatoes than they can sell. Sometimes a farmer may deliberately plant more cucumbers because they do not know in the end how much percentage of cucumbers would actually meet the standards set by the supermarkets, for example, some supermarkets only accept cucumbers that are straight and big enough to look good to customers. In the end, many small cucumbers and not good-looking ones cannot be sold, but they are perfectly edible and are just nutritious as the good-looking cucumbers. This can cause significant waste on farms, but this is not much the farm can do but to keep the over-production exercise, because just in case not to lose the market (Colgan, 2013). It is inevitable that these two types of waste (over-production and over-processing) happen often in agriculture reality because of constant pressure from the market. It can be often seen that fields of lettuce or peppers are left without being harvested, because the market is saturated and the price for the produces is low because of over-production or over-processing. It is not worth harvesting the crops anymore. Otherwise, the cost of harvesting may be higher than the price farmers can sell them (Pearce, 2018). There have been active researches in how to help reduce over-production and over-processing waste. For example, the 3Rs model (i.e. reduce, reuse and recycle) has been proposed to help front-line works in agri-food to reduce the waste from over-production, for example, by re-directing the food produce or products to charity organisation and schools, so that the over produced food can be used in time and for a good cause. Recycling in food industry is more about the packaging and facilities rather than food produce itself. A clear example for recycling is the re-use of plastic bags in food packaging in the last ten years. However, many believe that the 3R model in food industry is more about green rather than lean (Vlachos, 2015; Bloom, 2017). Other types of waste are mainly resulted from the relationships and interactions between different stages of supply chain (Cox, 2007; Amentae, 2018; Umar, 2021).

After considering all the waste categories mentioned above, in order to focus on the effort to tackle the most relevant ones in a limited time, the researcher excludes over-production and

over-processing wastes from this PhD investigation, as these two categories are mostly related to within organisation context. However, this study is more about crossing organisation boundaries in the supply chain context which needs to focus on the interactions, linkages and relationships between different supply chain members, thus the researcher only examines the impact of KMob on lean performance using five KPIs, namely, inventory reduction, quality assurance, cycle time or lead-time reduction, on-time delivery and smooth operation flow.

(1) Inventory reduction: one of the biggest concerns that companies have for their operations is the reduction of inventory since materials, work in process and finished products take up space in the stores but do not generate any added value (Viloria and Robayo, 2016). Droge and Germain (1998) indicated that inventory performance is measured by the inventory levels after controlling for the linear (or nonlinear) effects of context, environment, and organization. Thus, it can be seen efficient and effective inventory reduction plays a crucial role in the successful running and survival of a business firm (Hofer, Eroglu and Hofer, 2012; Slack & Brandon-Jones, 2019).

(2) Quality assurance: derived from the waste category of defective products in literature (Liu et al, 2013), to achieve the highest quality possible with minimum cost is considered the essence of a lean supply chain. In order to acquire quality assurance, the supply chain needs to remove the root causes of poor quality from the value processes by documenting the standard operating procedure and continuous training (Shah and Ward, 2003; Panigrahi & Bahinipati, 2019). This can be implemented by the use of total quality management in order to improve the overall quality of machinery and operations (Kannan and Tan, 2005).

(3) Cycle time or lead-time reduction: cycle time is the time required to complete a given process that is calculated from the initiation of the first operation through the entire supply chain. Cycle time reduction aims to identify and implement more efficient ways

of completing the operation (Agarwal, Shankar and Tiwari, 2006). According to Droge, Jayaram and Vickery (2004), in terms of procurement process, it requires the ability to minimize the time from order placement to the delivery of the procured item, which includes supplier lead time, transportation, receiving and inspection; in terms of manufacturing process, it requires the ability to minimize the time from when the order was released to the shop floor to the time of its completion.

(4) On-time delivery: on-time delivery is the main metric to measure the efficiency of supply chain processes. It is an indicator of how capable the organization is to meet customer demand in terms of the requested delivery date (Flynn and Flynn, 2004; Nematollahi & Tajbakhsh, 2020). A complete cycle of planning and execution helps improving on-time delivery performance, in other words, the capacity in planning of resources at manufacturing and delivery enhances the accuracy of the delivery promised date since the planning is based on loading of resources (Karim et al., 2010).

(5) Smooth operation flow: a key driver of lean supply chain management; it requires materials, products and information flow like water from the supplier through the production process to the customer. As Esper et al., (2010) mentioned, smooth operation flow as a strategic approach is bundling the customer value propositions from demand-side and supply-side operations that can create value in the marketplace (Slack & Brandon-Jones, 2019).

2.5 Research gaps

Based on the detailed analysis of the literature, a number of research gaps have been identified in exiting work:

- Knowledge mobilisation in SMEs have not received adequate attention in agri-food supply chain context;

- There is a lack of guidance and best practice for effectively implementing knowledge networks to support knowledge mobilisation in agri-food supply chains;
- Very limited solutions are available for crossing boundaries in knowledge mobilisation along agri-food supply chains.
- There is insufficient research on how knowledge mobilisation impact on reducing waste and cost to achieve lean agri-food supply chains;

This study will follow the definitions from the European Commission (2003) about categorisation of different types of organisations involved in agri-food supply chains. According to the European Commission, SMEs are organisations that have fewer than 250 employees. The annual turnover for SMEs should be no more than 50 million Euros, if measured by their annual balance sheet total, it should not exceed 43 million Euros. Compared with large companies such as Toyota Motor, an individual SME's annual turnover or balance sheet total are indeed too little, however SMEs are in fact the largest contributor in the agribusiness sector, simply because majority of the organisations involved in agri-food supply chains are SMEs, especially over ninety percent of farmers are family-own, family-run SMEs for many generations (Cox, 2007; Lamprinopoulou, 2011; Lefebe, 2018).

Knowledge mobilisation in most business environment has become everyday practice. However, the knowledge mobilisation in SMEs has not been widely exercised, simply because the high implementation cost and uncertain future benefits have prevented SMEs from investing their rather scarce/ limited time and resources in exploring knowledge mobilisation. Furthermore, Anastasiadis and Poole (2015) suggest one of the key issues concerning the low performance of AFSC is information-sharing constraints. In general, for efficient and effective SCM, an unobstructed flow of knowledge is a prerequisite, but the level of knowledge sharing is even more important. To that end, the current studies underline the importance of information sharing in AFSC (Anastasiadis & Poole, 2015). Another difficulty to the blockage of

information in SMEs is related to the dominant position and power of certain stakeholders in the agri-food supply chain. Usually, SMEs have very limited power over other supply chain members which forces SMEs to be more operational to survive rather than taking a more strategic approach to knowledge mobilisation. Even though most of the organisations involved in the AFSC are SMEs, yet they do not have much influence on strategic decisions at the supply chain level.

It is of course reasonable that some supply chain members are more powerful than others simply because they are in the right position inside the supply network structure, as discussed in Section 2.4.2. When a supply chain member in a position which can have links and interactions with more number of other members in the chain, they are often in a more advantageous position. For example, wholesalers are positioned between producers and retailers, in means that wholesalers can make this into an opportunity to influence others, either by blocking knowledge sharing if they do not wish to, or by refining or fabricating vital information that could be used for their benefit (Wolfert, 2010; Umar, 2021). The research findings suggest that there is co-relation between knowledge sharing and power asymmetry in inter-organisational relationships (Cheng, 2011; Boshkoska et al, 2019; Marques, 2020). Concerning the principal theme of commitment, the success of implementation of knowledge mobilisation considers management commitment.

However, because of some of the key difficulties SMEs have, for example, they usually are lack of dedicated required managerial and technical experts. In some cases, a farm may only have a husband-and-wife team to look after the whole farming business. They do not have extra staff to help them even if they wish to. For some farms, they have a few more employee, but because of the workforce availability, they cannot afford to provide good employment training or educational programs. SMEs also wish to see quick return for their investment and would not perceive knowledge mobilisation adoption as a long-term investment, which could

ultimately reduce the possibility of carrying out a knowledge mobilisation programme to the end, and likely to abandon the process at very early stage and lose the chance for reaping the benefits (Patzelt & Shepherd, 2011; Panigrahi & Bahinipati, 2019).

Additional barriers of the adoption of knowledge mobilisation in the agri-food supply chains are related with the industry's special characteristics. As the products flowing through the supply chains are high perishable, it is much hard to organise complicated large batch processes which is the norm in car manufacturing. The fact that organisations in agri-food industry do not seem to have the culture or tradition of share information and knowledge openly. They also are far behind other industries such as car manufacturing in adopting advanced techniques (Rao, 2006), for example that can help with more accurate and real-time forecasting. This lack of precise forecasting has been identified as a serious cause of the waste between suppliers and retailers (Mena, Adenso-Diaz, & Yurt, 2011; Taylor & Fearne, 2009).

There have been plenty of literature addressed the classic issue of sharing information and knowledge in supply chains (Lubell, 2014), many have developed theoretical and practical solutions with proven benefits from sharing information and knowledge. Most studies have focused on how retailers share their information on market and customer demand, by doing so the upstream supply chain members such as suppliers can make more precise decisions on their production amount and when to produce them, as well as how much inventory space should be allocated for the retailers, especially in case of using VMI (Kaipia, Dukovska-Popovska, & Loikkanen, 2013; Slack & Brandon-Jones, 2019). With regards to perishable agri-food foods, information and knowledge sharing has proven to be even more important means in reducing waste (Plan, 2011; Thron, Nagy, & Wassan, 2007; Zhao et al, 2020). Ferguson and Ketzenberg (2006) found out that information and knowledge sharing were more beneficial when the demand was varied, fluctuated or unpredictable, and that when products were perishable and more expensive. The above findings are confirmed by Thron et al. (2007), who discovered that

the agri-food supply chain having perishable goods could actually benefit much more from information and knowledge sharing compared with other types of supply chains.

It was also suggested that agri-food supply chains with perishable products should adopt centralised control mechanisms, for example, using CPFR (Collaborative Planning, Forecasting and Replenishment) which should lead to an improvement in the overall supply chain performance. Research further concluded by improving communication, information and knowledge sharing, and collaborative forecasting could help reduce costs and waste in the whole supply chain (Kaipia et al., 2013; Saeed, Waseek & Kersten, 2017). These studies provided valuable background knowledge for this study. However, there is still insufficient academic literature that have focused on providing empirical evidence on how agri-food supply chains actually share knowledge and information to reduce all types of waste in practice (waste reduction is the main principle of lean). This PhD study aims to fill the gap in literature.

Knowledge mobilisation is concept that encompasses a number of other models of knowledge use including knowledge networks (Olan et al, 2022), communities of practice, knowledge brokering and so on. Each of these concepts is interrelated, overlapping and is distinguished by which step between knowledge and change in practice that each focuses on (Liu, 2020). The goal of knowledge networks is to create relationships, trust and knowledge sharing between members for the purpose of developing more inclusive economies, societies and institution of governance (Creech & Willard, 2001; Zhao et al, 2021). Knowledge networks are particularly important in the knowledge mobilisation project as the relationships on which these networks are founded are also a source of credibility and influence in the decision-making process. One of the characteristics of knowledge network is that can result in a reduction of boundaries between sectors such as industries and universities. However, perhaps the most serious drawback of knowledge mobilisation research is that many studies have been built on a separate framework. Thus, this study aims to fill this gap by using networks to create a self-propelling

knowledge mobilisation process.

To address these gaps, this study attempts to integrate key factors affecting supply chain networks, knowledge mobilisation crossing boundary and improving lean performance KPIs in agri-food supply chain context. Such analysis will explore how knowledge boundaries can be identified and how different supply chain actors using appropriate boundary crossing mechanisms, and that how knowledge mobilisation will impact on lean supply chain performance. An innovative knowledge mobilisation framework will be proposed, which will be discussed in detail in the next section.

2.6 The conceptual framework

This section explains the formulation of the conceptual framework based on the literature. A knowledge mobilisation conceptual framework has been developed in this study, short for conceptual KMob framework, as shown in Figure 2.9. The conceptual KMob framework consists of three main components: key factors that could erect or help remove knowledge boundaries, boundary-crossing mechanisms and supply chain lean performance KPIs. The components and their key elements of the KMob conceptual framework are:

- **Key factors** that could erect or help remove knowledge boundaries. In total eleven key factors were identified from literature: collaboration, supply network structure, power, technology, trust, commitment, training/education, time, cost, culture and continuous improvement. Knowledge boundaries can be classified into three main categories: syntactic boundary, semantic boundary and pragmatic boundary.
- **Four boundary-crossing mechanisms**: boundary objects, boundary spanners, boundary practice and boundary discourse. For each type of the boundary-spanning mechanisms, specific elements have also been identified. For example, boundary objects can be physical or digital artefacts, models or prototypes.

- **Five lean performance KPIs**: inventory reduction, quality assurance, lead-time reduction, on-time delivery and smooth operations flow.

The two block arrows represent relationships between the components, that is, boundary-spanning mechanisms will help overcome the barriers and cross knowledge boundaries erected or removed by key factors, and the boundary-spanning mechanisms will impact on supply chain lean performance KPIs, hence the boundary-spanning mechanisms take the central position in the conceptual framework.

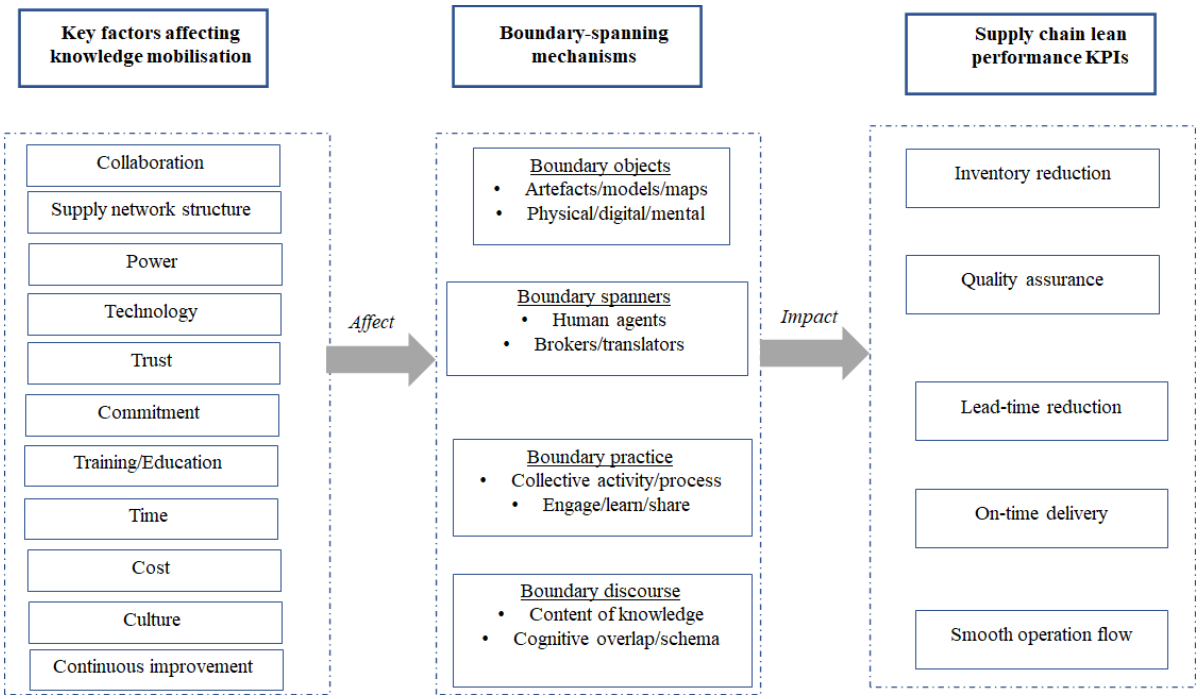


Figure 2.9: Knowledge mobilisation conceptual framework

2.6.1 Key factors and boundaries that can be created by key barriers

A knowledge boundary can be seen as the limit or border of a person's knowledge base. This boundary is of course in relation to a different domain of knowledge (Liu, 2020). There are many reasons that could cause knowledge boundaries. For example, the differences between different people's own knowledge base. People can have different way for work, different ways to share knowledge and expertise. In the agri-food supply chain context, people from different

stages of the supply chain may have very different organisational culture (Mileva Boshkoska, Liu, & Chen, 2018). When Paul Carlile started to investigate knowledge boundaries in early 2000s, he developed a topology of knowledge boundaries based on the level of novelty of the collective tasks being undertaken by those who involved in knowledge sharing. He distinguished the novelty level from low to high. Subsequently, Carlile classified knowledge boundaries into three types: syntactic boundaries, semantic boundaries and pragmatic boundaries (Carlile, 2002 ; Carlile, 2004). These three types of knowledge boundaries are important for the development of boundary-spanning mechanisms for Knowledge Mobilisation Conceptual Framework in this study. Carlile's original classification was based on his research in product development and manufacturing context. Later work has extended to wider research context and investigated more types of boundaries that could underpin Carlile's three types of knowledge boundaries. For example, geographic boundary could be the cause for syntactic boundary, social boundary and cultural boundary could be the cause for semantic boundary, and organisational boundary and activity boundary could be the reason for pragmatic boundary (Liu, 2020).

- **Syntactic boundaries**: this type of boundary is believed to the easiest to cross for knowledge mobilisation, because it is assumed to be with low level of novelty of the collective tasks being undertaken by those involved in the knowledge mobilisation. When the novelty of the collective work is low, it mean that there is little innovation or new ideas involve, it is often the case that people involved in the collective work share a common logic, a set of values and worldview, hence it is likely the knowledge boundary can be crossed successfully (Jashapara, 2011; Liu, 2020)
- **Semantic boundaries**: when the novelty of the collective tasks increase, people involved in the tasks may not have a shared logic or shared values anymore. By losing the common logic, problems can be easily created for sharing ideas, information and

knowledge. Very often people will have different understandings and interpretations of the same idea or concept. At the semantic boundary, a significant more effort will be needed to cross it (Carlile, 2002; Carlile, 2004; Jashapara, 2011; Liu, 2020).

- **Pragmatic boundaries**: among the three types of knowledge boundaries, pragmatic boundary faces the highest level of novelty of the collective tasks. When the novelty of the collective tasks increases to a certain threshold, people will start to have not only very different interpretations and understandings of problems, events and ideas, but also very different interests or different preferences in the interests. This will ultimately result in disagreements and conflicts among different individuals or organisations as supply chain members. Because of these differences in their interests or preferences, some researchers refer pragmatic boundary as political boundary. In reality, pragmatic boundaries are the most complex to understand and the most difficult to cross successfully (Filstad, Simeonova, & Visser, 2018).

In simple terms, what really lacks at three different types of boundaries are:

- **At the syntactic boundary**: lacks common languages, technical terms, vocabularies, or lexicons.
- **At semantic boundary**: lacks common understanding and interpretation.
- **At the pragmatic boundary:** lacks common interests.

These knowledge boundaries can erect great barriers to knowledge mobilisation, subsequently hinder coordination and collaboration along supply chains to achieve their overall performance. The pressure from globalisation of supply chains requires business decision makers to respond and act quickly across the whole supply chain. This has highlighted that there is an urgent need to find solutions to overcome any knowledge boundaries along the supply chain. The next section will discuss four categories of boundary-spanning mechanisms to address the issue.

2.6.2 Four boundary-spanning mechanisms

Identification of knowledge boundaries is one thing, how to cross them is quite another. The assumption of permeable boundaries should not be taken for granted, especially in supply chain context. This section explains the four categories of boundary-spanning mechanisms that have been included in the KMob conceptual framework. They are boundary objects, boundary spanners, boundary practice and boundary discourse (Carlile, 2002; Carlile, 2004; Jashapara, 2011; Boshkoska et al, 2019). Boundary objects and boundary spanners are relatively well-known mechanisms, while boundary practice and knowledge discourse are quite new concepts and under researched (Liu, 2020).

2.6.2.1 Boundary objects

Boundary objects are basically artefacts. Nowadays, boundary objects can be in many different forms, for example, some of them may be physical, others may be abstract. Some researchers even believe mental artefacts can also be used. If boundary objects can help to cross knowledge boundaries, that will have to be common to a number of knowledge domains, hence can be served as a focal point in collaboration, so that different parties can use the artefacts to represent, transfer and share ideas and knowledge (Hawkins, 2012; Hayes & Fitzgerald, 2009). It is important that knowledge can be transformed from one domain to another, hence boundary objects should be able to help to de-contextualise and de-personalise knowledge, because decontextualised and de-personalised knowledge is easier to be transferred and mobilised. One key requirement for a good boundary object is its flexibility, in the sense that it should allow people from different domains to attach localised meanings to the boundary object. When there is enough common, shared meaning across different knowledge domains, the boundary object will be able to help people to bridge their cognitive gap, hence have smooth knowledge mobilisation (Koskinen, 2005; Boshkoska et al, 2019). Here are some of the most often used boundary objects:

- **Knowledge repositories**: these are widely used boundary objects which can supply a common reference point of data, measures or labels across different knowledge domains. Knowledge repositories often help to share definitions and values for solving specific problems, for example, a food gene bank, a food nutrients database and a food chain library (Liu, 2020).
- **Standardised forms and methods**: workers like to use standardised forms, for example many agri-food supply chain players such as supermarkets and other types of retailers need to follow standards for food labelling. Food standards agency use pro-forma for food quality inspection. Because standardised forms are in a mutually understood structure, it is much easier for people to get the gist of the ideas and knowledge, subsequently sharing knowledge becomes less difficult (Zhao et al, 2020b).
- **Models**: there can be many different types of models, from physical product prototypes to digital representations. For example, people often use flow-charts to present ideas for food processing. Supply chain networks are used to analyse how products, information and knowledge can flow across different nodes in the chain. In addition, food gene sequencing models and computer simulations are frequently used to help understand complex reality more easily (Jashapara, 2011; Filstad, Simeonova & Visser, 2018).
- **Maps of interdependency**: this type of boundary objects are extremely useful in knowledge activities across supply chains because interdependency among different supply chains represents the interactions and linkages in the chains. Visualising the interdependencies in maps makes the dependencies and boundaries more transparent and at a more systemic level. One good example would be using ontologies to outline the interdependency among food processing activities, food waste and product shelf-life (Boshkoska et al, 2019).

In literature, the application of boundary objects has been mainly in engineering context such as in product design and development. For example, product assembly drawings and process flow charts have been successfully used in automotive industry and electronics industry for a long time to help bridge the gaps between design, manufacturing and production planning functions (Carlile, 2002; Carlile, 2004; Filstad, Simeonova & Visser, 2018).

2.6.2.2 Boundary spanners

Boundary spanners are people who can frame and translate knowledge from one domain to another. Boundary spanners aim to promote knowledge sharing and leaning, therefore they often play a significant role in facilitating the co-ordination and collaboration among individual persons and organisations from different domains (Hawkins, 2012; Zhang, Wu, & Henke Jr, 2015). It is reasonable to infer that knowledge spanners can also support knowledge mobilisation in agri-food supply chain context. Having the right knowledge spanners will make a big difference on the outcomes of knowledge mobilisation activities, because the standing of the knowledge spanners and their social relationships in a supply chain and organisation are important factors to reflect their power and influence, subsequently affect the effectiveness of knowledge mobilisation activities. Another important question to ask is how can someone become a boundary spanner? What are the criteria to choose a boundary spanner? The legitimacy of boundary spanners is usually through membership. Based on the membership status, boundary spanners can usually be differentiated:

- **Boundary translators**: they are usually people who only belong to one organisation or supply chain member at the knowledge boundary (Brown & Duguid, 1998; Liu, 2020).
- **Boundary brokers or boundary crossers**: these two terms both refer to people who belong to both organisations or two supply chain members at the knowledge boundary. Knowledge brokers were used in (Brown and Duguid,1998) meaning who have memberships in both parties that are involved in the knowledge sharing process as

knowledge brokers while boundary crossers were used in (Hayes and Fitzgerald, 2009).

- **Marginal people**: sometime at the knowledge boundary, there are people who have membership in multiple parties, and they are named marginal people (Star & Griesemer, 1989; Alexander, Teller & Roggeveen, 2016).

All types of boundary spanners have their advantages and limitations. Boundary translators can be tempted to bias knowledge translation because they belong to one party only at the boundary, it is understandable if they tend to favour one organisation or supply chain member over another, (Ikujiro Nonaka et al., 1998; Liu, 2020). One may think that having boundary brokers or crossers would make the knowledge mobilisation cross boundaries really easy because boundary brokers and crossers have dual membership status. However, research findings do not support this assumption (Hayes & Fitzgerald, 2009). For marginal people, having membership status in multiple communities sometimes make their status a bit awkward, because they may still feel unaccepted in all parties or organizations at the boundary. This implies that having membership alone does not necessarily make the knowledge mobilisation crossing boundaries straightforward.

2.6.2.3 Boundary practice

As it is well-known that the best way to learn is from practice, that is, learning by doing. This is the reason for boundary practice. When people coming from different knowledge domains are engaged in collective activities, they observe each other how to do things during which knowledge is mobilised sometime without people realising it. This is especially true if the knowledge is in tacit form (Hawkins & Rezazade, 2012; Liu, 2020). Firstly, boundary practice needs to engage people from different domains in a shared space or working setting. It is often the case that new knowledge can be created when people are engaging in collective practice because it creates a situation that people can inspire each other, bounce ideas over, and often existing knowledge is refined, improved or new knowledge is created. Boundary practice is

most effective than other boundary-spanning mechanism (i.e. boundary objects and boundary spanners) in addressing knowledge boundaries involving tacit knowledge.

It has to be mentioned that sometimes people mix boundary practice with another term, that is, routine practice. However, there are clear difference between the two concepts. Routine practice are well-established operations that people practise regularly, but boundary practice has significant novelties for experts from different knowledge domains. Boundary practice may involve some overlap of activities from different people at the boundary, however the practice itself is not specialised to a particular party or organisation or supply chain member. In fact, a certain type of boundary practice will only emerge from a particular context plus the participating individual's collective activities (Hawkins & Rezazade, 2012; Liu, 2020). There are clear different between boundary practice and specialised practice too. Boundary practice is not assignable to specific sub-tasks nor separable from the collective tasks, hence boundary practice has to be performed together and cannot be delegated to experts in their specialised knowledge domains (Nicolini, 2011). Compared with boundary objects and boundary spanners, boundary practice is still a new boundary spanning mechanism, and research in this area is still in its infant stage.

2.6.2.4 Boundary discourse

Boundary discourse is about how to design the content of knowledge in order to deliberately shape the conversations or dialogs that are to be taken among experts from different domains (Hawkins & Rezazade, 2012; Liu et al, 2019; Liu, 2020). Its main concern is to what is communicated. In order to help different parties, organisations or supply chain members at the boundary to close their cognitive gap, it is vital that the conversations can be well guided to achieve convergence. Experts coming from different domains may not necessary be able to engage in a dialogue to acquire the right knowledge, hence a certain level of conceptual overlap (in-between-ness) will be extremely useful to involve experts properly.

The four categories of boundary-crossing mechanisms can be compared from several perspectives (Liu et al, 2019; Liu, 2020; Zhao et al, 2020b):

- **Unit of analysis**: the unit of analysis for boundary objects is the artefacts, while the unit of analysis for boundary spanners is people, the unit of analysis for boundary practice is collective activities, and the unit of analysis for boundary discourse is the content of conversation or dialog.
- **Important attributes of the units**: for boundary objects, the most important attribute is shared meaning, whether it is in material form, in physical form, in abstraction or in mental presence. For boundary spanners, the most important attributes are their membership status, their personalities, skills, cognitive capabilities, and various types of relations. Two important attributes for boundary practice should be engaging and collective activities, without them boundary practice cannot materialise. Key attributes for boundary discourse can include ideas, domains of knowledge and cognitive proximity.
- **Type of knowledge shared at the boundary**: knowledge is generally classified into two types, tacit or explicit knowledge. Tacit knowledge is the knowledge types that resides in human minds, is difficult to articulate or document, but based on personal experience. Hence, among the four categories of boundary spanning mechanisms, boundary practice is most effective with tacit knowledge. Conversely, exp[licit knowledge can be easily captured, structured, written down and stored, hence will suit for the other three mechanisms (i.e. boundary spanners, boundary objects and boundary discourse).
- **Knowledge spanning functions**: the main knowledge function of boundary objects is of course objectifying concepts, by giving knowledge a visible form, hence becomes easier for sharing. Without using boundary objects, some knowledge may be difficult

to be noticed, let alone be shared. In comparison, the main knowledge function of boundary spanners is translating, framing or sometimes reformulating knowledge from one domain to another. The main knowledge function for boundary practice is creating new knowledge via performing collective actives together. The new knowledge can usually help to fill the knowledge gaps between people from different knowledge domains. Finally, the main knowledge function for boundary discourse can be selecting and situating conversation on specific ideas, themes and events, in the meantime articulating boundary discourse can help clarify the knowledge of one side to be transferred to the other side.

All four categories of boundary-spanning mechanisms may work alone individually or together in a combination form. to support each other in the knowledge mobilisation activities at boundaries (Liu, 2020). In fact, the four categories of boundary-spanning mechanisms provide four complementary perspectives. Boundary objects provide an *artefact* perspective (i.e. what objects are used to facilitate knowledge activities), boundary spanners provide an *actor* perspective (i.e. who is engaging in the knowledge mobilisation), boundary practice provides *the activity perspective* (i.e. by doing what joint activities while knowledge is mobilised), finally boundary discourse provide the *content perspective* (i.e. what is communicated during the dialog for knowledge mobilisation) (Liu et al, 2019). Boundary spanners, as actors, actively organise, facilitate and co-ordinate the joint actions of boundary practice. Boundary objects are needed for both boundary spanners while undertaking boundary practice in facilitating knowledge activities. In any boundary-spanning knowledge process, the content of the conversation or dialog (i.e. knowledge discourse) is really important to both boundary spanners and boundary practice. That is why in reality, multiple categories of boundary-spanning mechanisms are often used together in harmony.

2.6.3 Five supply chain lean performance KPIs

In Section 2.4.4, details of various lean supply chain performance measures have been discussed. In the context of agri-food supply chains, five KPIs have been selected for further Investigation in this PhD project, in particular to find out what impact would the boundary-spanning mechanisms have on these lean performance KPIs. The five KPIs are inventory reduction, quality assurance, lead-time reduction, on-time delivery and smooth operations flow. Empirical evidence of the impact will be established via Chapter 5.

2.7 Summary

This chapter introduced the concept of SLR and explained the details of SLR process. In total, 81 papers were included in the SLR. A number of key characteristics of the papers are analysed such as publication year, geographic distribution of research, and journals publishing the papers. The main types of research methods used in literature are also examined. The thematic analysis of the literature identified four main themes: key factors affecting supply chains, sustainable supply chain management, knowledge mobilisation in supply chain context, and supply chain lean performance.

Research gaps have been identified in existing work which provide justification for research of this PhD. A conceptual knowledge mobilisation framework is proposed based on the main findings from SLR. The conceptual framework will provide guidance to the next stage of PhD project, that is, the empirical stage to be detailed in Chapter 4 and Chapter 5.

The next chapter presents in-depth discussion of the research methodology in this study for the empirical work.

Chapter 3 Research methodology

3.1 Introduction

This chapter pays attention to the construction and justification of a proper study methodology, and the chapter is divided into three parts:

- It explains a methodological framework together with the research philosophies for identifying the proper philosophical stance, namely, the Ontological, Epistemological and Axiological.
- Research methods, strategy, design and approach are defined and justified.
- It proves whether the proposed methodology is reliable and valid as well as offers the evidences.

3.2 Research philosophy

Research methodology is defined as the way to choose, reflect on, assess as well as justify philosophies, techniques and strategies, and researcher applies it to knowledge generation and conclusion production based on the obtained knowledge (Walliman, 2005). A 'Research Onion' model is defined by Saunders et al. (2019) which gives an overview of research methodology as shown in Figure 3.1, which explains the Research Onion consisting of six layers of research methodology. The first element refers to the definition of research philosophies. The onion provides a correlation for peeling away layer after layer before an effective research strategy and design is selected.

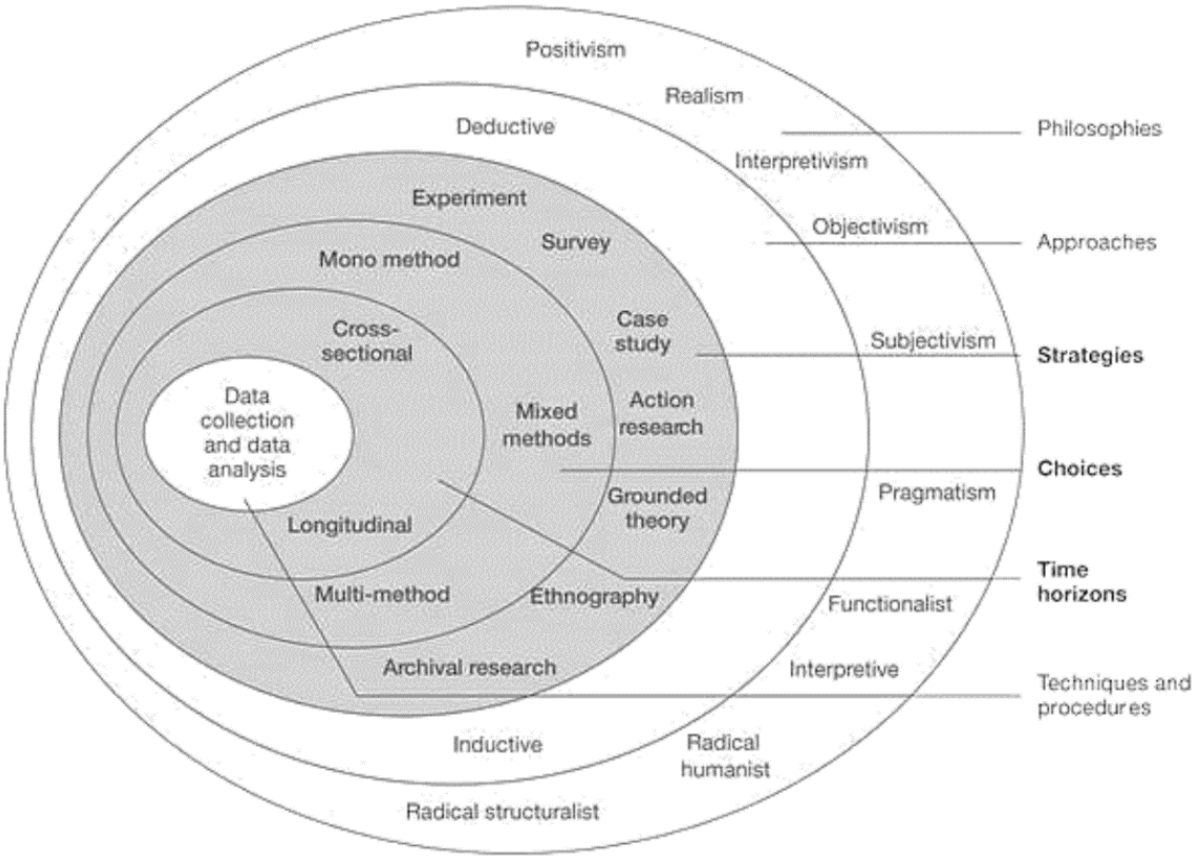


Figure 3.1: Research onion (M. Saunders et al., 2019)

The term 'research philosophy' is overarching and involves knowledge development and knowledge nature. It mainly explains how researchers look on the world nature and how they think of establishing acceptable facts from both existing and new knowledge. The understanding of philosophical issues is vital since there are at least three reasons: First, research philosophy can help researchers to clarify their research designs and to confirm those that are practicable, thus researchers are competent of identifying, and even establishing a design which may goes beyond their previous capabilities (Easterby-Smith, Thorpe, & Jackson, 2012).

Saunders et al. (2019) discussed three major thinking ways of research philosophy: ontology, epistemology and axiology. Ontology aims to answer the questions about what the nature of is knowable and what is the nature of reality. In epistemology, the interests are in what people

can know, how they can know, as well as which knowledge is right. Axiology is about what role researchers' values play in their research choices. The assumptions complement the formulation of the research philosophy (Denscombe, 2014). Positivism, critical realism and constructivism are three types of research philosophies. Table 3.1 provides a comparison of the three research philosophies and techniques for data collection.

Critical realism is a relatively new approach to ontological, epistemological and axiological issues. The philosophy of critical realism concerns *"explaining what we see and experience, in terms of the underlying structures of reality that shape the observable events"* (Saunders et al. 2019, p. 138). The fundamental tenet of critical realism is that we can use causal language to describe the world and the fundamental aim of critical realism is explanation, answers to the question "what caused those events to happen?". Critical realism has a stratified rather than flat ontology and this has major epistemological implications. Critical realists state that in the real world, managers should be encouraged to think about why certain decisions lead to certain outcomes and to try to explore what causes them (Sayer, 2010; Easton, 2010).

Pragmatism can provide a very powerful justification, not only interpret the social world through different methods, but also understand the impact of actions to provide motivation to the actions. Moreover, pragmatism is concerned with the interplay between knowledge and action. As a result, it can serve as a foundation for research approaches intervening into the world and not merely observing the world (Goldkuhl. 2012). The difference between critical realism pragmatism is that the acceptance of the possibility of knowing reality. The latter generally focuses on uncovering the constructions that social actors make instead of concentrating.

Table 3.1: Taxonomy of philosophical approaches in business and management research

(Howel, 2012; Saunders et al, 2019)

Paradigm	Positivism	Critical realism	Constructivism
Ontology (nature of the reality)	Realist ontology: Objective reality is under the control of natural laws. Truth can not be affected by inquirer's subjectivity.	Critical realist ontology: There is indeed a real world, while it cannot be well understood because people always see it through the subjective lens of researcher.	Relativist ontology: Objective truth does not exist. Reality is what people perceive.
Epistemology (relationship between the knower and the knowable)	Objectivist epistemology: Researcher is capable of fully understanding the (objective) reality. Research remains objective and is unbiased by independently collecting empirical evidence as well as conducting impartial analysis.	Modified objectivist epistemology: Researcher can pursue to be as objective as possible, while objectivity cannot be well reached and subjectivity cannot disappear.	Subjectivist epistemology: The knower and the knowable can be fused into one. Research finding assists in constructing the relationship. Thus, the known will always be affected by knower's personal opinion and partiality.
Axiology (role of value)	Research proceeds involving no value; researcher remains objective and is data independent.	Research is valuable. Researcher has clear biases because of their cultural background, world view and living experience, which can all affect research.	Research has its value. Researcher also belongs to research object, and thus shall not be isolated from research. Thus, research may be subjective.
Methodology (how should knower find out knowledge)	Empirical methodology: States hypothesis beforehand and performs empirical research when conditions are controlled, aiming at finding reliable results that can be generalized.	Methodology: Realise the significance of research background and that of the way to reduce subjectivity via triangulation.	Attempts to explain the subjectivity shared by researchers for illusion minimisation and consensus creation. The generalisation out the context is of no meaning.
Research techniques	Often deploys quantitative methods of data collection (such as questionnaire and sampling) as well as statistical methods regarding data analysis.	Deploys both qualitative and quantitative techniques for data collection. Statistical analysis together with interpretive methodologies.	Normally adopts qualitative data collection techniques (such as observation and interview); accounts for contextualized findings.

Cycle of inquiry	Research first proposes a hypothesis which is usually on the basis of early studies, and then conducts empirical tests for verifying or falsifying the proposed operational hypothesis (deduction). New theories may be created accordingly (induction).	Iterative cycles of induction and deduction.	Research can first propose a hypothesis followed by conducting related observation (deduction) or start with data collection and new theory grounding based on empirical evidence (induction), or the combination of the two.

Ontological assumption states that objectivism and subjectivism explain continuum polar opposites by virtue of different philosophical positions aligned between them. Relying on it, researcher is capable of claiming the definition as well as the construction of knowledge (Creswell & Creswell, 2017). Because the study partially discusses the complicated interactions between people (farmers, food processors, wholesalers/distributors, retailers and consumers) and processes (knowledge mobilisation, lean management and supply chain management), its ontological stance leans towards constructivism as each organisation holds a changing understanding about the real world (in agri-food SCs and lean decision and knowledge mobilisation) and the social construction of knowledge changes with passage of time. Besides, constructivism is chosen in that there can be multiple realities within organisations/participants contain many realities, and those realities involve different thought schools on each terminology of knowledge, agri-food SC and lean decisions.

Epistemological assumption presents two epistemology views, namely, positivism and anti-positivism (interpretivism). In the view of positivists, people are capable of explaining as well as predicting things that happened in social world via finding out a relationship pattern between them. Anti-positivism, by contrast, hold the position that science is incapable of creating any kind of true objective knowledge (Creswell & Creswell, 2017; Greener, 2008). The interpretivism is the approach chosen by the study because under its assumption, existence of

socially-constructed multiple realities understands agri-food supply chain stakeholders' behaviour rather than predicts it.

In axiological assumption, axiology defines how researcher views the role played by values in research. This study pays more attention to value laden because it focuses on soliciting researchers' opinions and experience as well as embodying their values into the study. The study analyses scholars' various views as well as finds that knowledge does not remain constant and changes over the time. However, there is a debate that new knowledge is created largely affected by a person's experience. Hence, the study gives the assumption that research can be partially affected by others' views and opinions and can hardly be value free.

3.3 Research approach

The research approach is to organise research activities and involves techniques to collect and present data. It aims at enabling research activities to achieve their goals to the largest extent. There are two fundamental research approaches, namely, deduction and induction. The difference lies in that the former is for testing theory and the latter is for building theory (Saunders et al., 2019). Justifying theoretical development is normally based on research questions: phenomena and theory-driven questions. Regarding theory-driven questions, it means that the research tries to understand the subject in a wider range based on early studies. Under such categorisation, the researcher devises a different theoretical framework based on early studies and conducts inductive studies based on the framework. Such research is suggested to take formerly related studies as research foundation. On the other hand, regarding phenomena-driven questions, despite insufficient theories offering adequate description, investigation has been conducted, highlighting related issues in the subject or field. Then, research extrapolate new understandings and ideas considering empirical evidence availability, the importance exhibited by the phenomenon in question, as well as theory relevance (Eisenhardt & Graebner, 2007).

A deductive approach involves the development of a theory that is subjected to a rigorous test. There are three advantages to using a deductive approach: First, it can explain causal relationships or links between concepts and variables; Second, it can measure concepts quantitatively; and then it can generalise research findings to a certain extent (Saunders et al. 201 9). As for an inductive approach, it involves *"the search for pattern from observation and the development of explanations – theories – for those patterns through series of hypotheses"* (Bernard. 2011, p. 7). Generally, this approach can help to build a theory through identifying patterns and relationships in the collected data (Saunders et al. 2019). The main difference between the inductive approach and the deductive approach is that the inductive approach aims at building a theory, while the deductive approach focuses on testing or evaluating a theory.

Creswell (2017) offers the following two practical standards for determining whether a study will be deductive or inductive. First, the nature of the research topic. It will be advised to use a deductive approach if there is a wealth of literature that can assist researchers in developing a theoretical framework. Otherwise, an inductive approach will be suggested. Second, the available time for conducting research. Deductive research can be finished more quickly than inductive research, however inductive research can be much more protracted. Given the previous explanations of the deductive and inductive approaches, it is preferable to combine the two approaches: inductive and deductive approach (abductive approach) in this study.

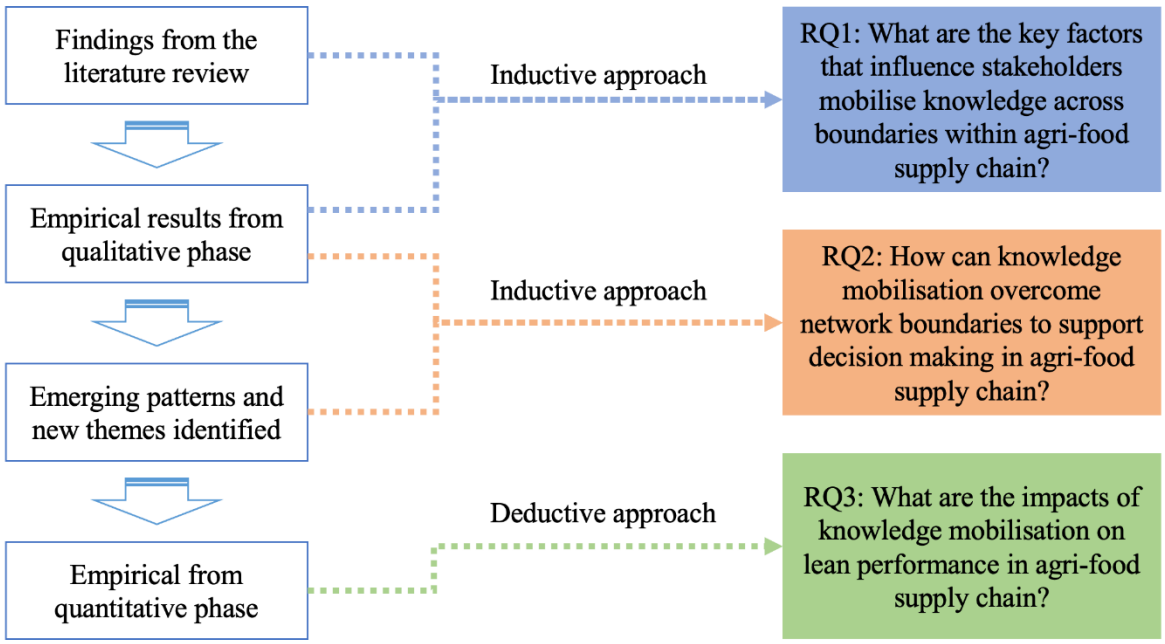


Figure 3.2: The research approaches connecting research questions and findings

An inductive approach is adopted for investigating the literature as well as establishing lean, knowledge mobilisation and supply chain principles. The key factors of effective knowledge transfer and sharing is put forward, followed by the construction of a conceptual KMob framework. Besides, an inductive approach assists in building theory aiming at validating the conceptual framework and generating data analysis results. As can be seen below, Question (1) included an inductive aspect when analysing findings in the literature. Question (2) was based on an inductive process, with a new theory being developed (see Figure 3.2). Deductive research needs to develop a theoretical structure before empirical observation, by contrast, inductive process moves from specific observation to wider generalisations and theories. The study holds a final goal of understanding from a new perspective the issues regarding KMob in lean agri-food supply chains: in other words, respond to research question (2). The quantitative phase is needed after the qualitative phase regarding the research findings, to further investigate the impact of knowledge mobilisation on lean performance for contributing more significance to research findings. Therefore, quantitative data are collected from a wider

audience of agri-food chain actors in order to manage knowledge deductively, corresponding to research question (3).

3.4 Research strategy

Research strategy, which is defined as the way that research is conducted, mainly pays attention to research approach. There are many research strategies in the field of social science, thereinto, the most commonly used are action research, grounded theory, hermeneutics, ethnography and mixed methods (Saunders et al., 2019; Howell, 2012).

The grounded theory refers to the theory formed based on data which receive systematic collection and analyses during research process' (Corbin & Strauss, 2014). Under the theory, researcher is not required to form an initial theory but shall develop data after observations. Based on the data gathered, predictions will be conducted, followed by data generation and test (Saunders, Lewis, Thornhill, & Bristow, 2015). Qualitative studies usually use grounded theory strategy for analyses (Denscombe, 2007; Patton, 2005). Even so, the study did not adopt it because it was not suitable for the precise study planning.

Hermeneutics deals with ancient scriptures and places emphasis on historical and social background surrounding actions during text interpretation. People are provided with a situated context for interpreting historical data, in the context, they can participate the interpretation process. Hermeneutics helps to interpret and understand the past, thereby helping to realise the data validity and truth. Hermeneutics requires to engage with self, including pre-conceptions, subjectivity and bias (Garrison, 1996). Hence, it works as a critical theory paradigm, thus can be treated as a proper methodological approach. Thus, it is not suitable for this study because its philosophical assumptions run counter to the underpinning philosophy of the study. Moreover, this study requires to evaluate the conceptual KMob framework via a set of procedures, however hermeneutics holds the view that understanding mainly works for

interpreting, it is the foundation of human condition instead of the outcome of procedural processes, also proving its inappropriateness (Howell, 2012).

The ethnographic approach, on the basis of anthropology, comprehends human activities with knowledge obtained and shared in society. Ethnography investigates social phenomenon via inductive processes instead of deductive process and hypotheses testing. Data analysis of ethnography, first interprets meanings and actions, more employs qualitative explanation compared with quantitative techniques (Aktinson & Hammersley, 1998). Furthermore, as ethnographic studies are undertaken longitudinally, it may last for a longer period for confirming the change of an object or phenomenon. From the above point of view, ethnographic does not suit for the study (Croom, 2009).

Action research shows a close association with the participatory paradigm of inquiry. It mainly lays emphasis on performing research with people, instead of only taking their information as reference. Participants participate in the research by groups or by organisations (Howell, 2012). The methodology aims at removing the imbalance between the researcher and the researched, as well as creating a democratic open research environment. Action research focuses on solving professional problems under given background by virtue of democratic inquiry, enabling professional researchers to work with the local stakeholders to engage in finding and developing effective problem solutions that are the most important to the stakeholders (Greenwood & Levin, 2000). This study doesn't demand the researcher to participate in the investigation, process or phenomenon, and the researcher of the study also does not participate in such process besides the investigation of some issues and the evaluation of proposed KMob framework. Based on these reasons action research is unsuitable for this study.

The mixed methods strategy is employed by researcher for collecting, analysing and integrating qualitative and quantitative data in single or multiple studies under a constant inquiry programme. Researchers, after using various methods for investigating the same subject,

become more confident in research findings (Creswell & Creswell, 2017). In the research by Creswell and Clark (2007), four types of mixed methods strategies were mainly put forward: (1) triangulation (merging qualitative and quantitative data to understand a research problem), (2) embedded (using either qualitative or quantitative data to answer research questions within a largely quantitative or qualitative study), (3) explanatory (using qualitative data to help explain or elaborate quantitative results) and (4) exploratory (collecting quantitative data to expand and give more meaning to the findings from qualitative data). With the principles of exploratory, the mix methods would be the most appropriate strategy for this study because the findings of qualitative phase will inform the formulation of quantitative phase which is sequential approach. In this study, it has exploratory research characteristics where quantitative data were used to expand and provide more meanings to the findings from qualitative data. This provides the opportunity for theoretical research and hypotheses testing including the effective use of the conceptual KMob framework. Hence, it is allowed to examine the student findings by comparing different methods for analysis and for the generalisation of different views (Denscombe, 2007). This study focuses on evaluating how the knowledge mobilisation framework is potentially applied in agri-food SCs in the context of to achieve lean performance. The study employs expert interviews (qualitative) and a survey questionnaire (quantitative) for answering the three research questions in Chapter 1.

Interviews offer mechanisms of data collection, enabling to describe, interrogate, evaluate and consider personal accounts or historical and biographical data; interviews are allowed to be confrontational, to create a storytelling environment. The interview has been institutionalised, and the norms embodied within it are the second nature for individuals in society, hence, there is no need to conduct a lot of training; they are technical constructs that anyone is capable of conducting them (Howell, 2012).

It is regarded that a survey suits this study for the study needs to collect data from a great

number of participants for investigating their different understandings so as to realise the research objective. This contributes to a better insight and it allows the capturing of the perceptions of individuals. A survey strategy shall focus more on controlling the research process and during sampling, findings representative of the whole population can be generated at a lower cost compared with data collection for the whole population. For ensuring that the sample is representative, the respondents in this study are the individual stakeholders in the agri-food industry, with a role in supply management, lean management or knowledge management and workers contributing to the lean agri-food projects. A wide range of respondents are chosen for including a sufficient number of participants at different stages of the supply chain, with different roles in the multi-organisational setup of agri-food SCs, so that knowledge boundaries can be observed which is a key element of the PhD study.

3.5 Research design

Research design is of vital significance for the whole research process, with the aim of proving a plan allowing to accurately assess the subject being investigated, establishing answers to the research questions of a study and determining study scope (Rousseau & Fried, 2001). Research design involves discussing the concepts of reliability and validity, and identifying main influences brought about by employing various time horizons for research design. Besides, some major ethical issues emerging from the selection of research strategy are also encompassed (Saunders et al., 2019).

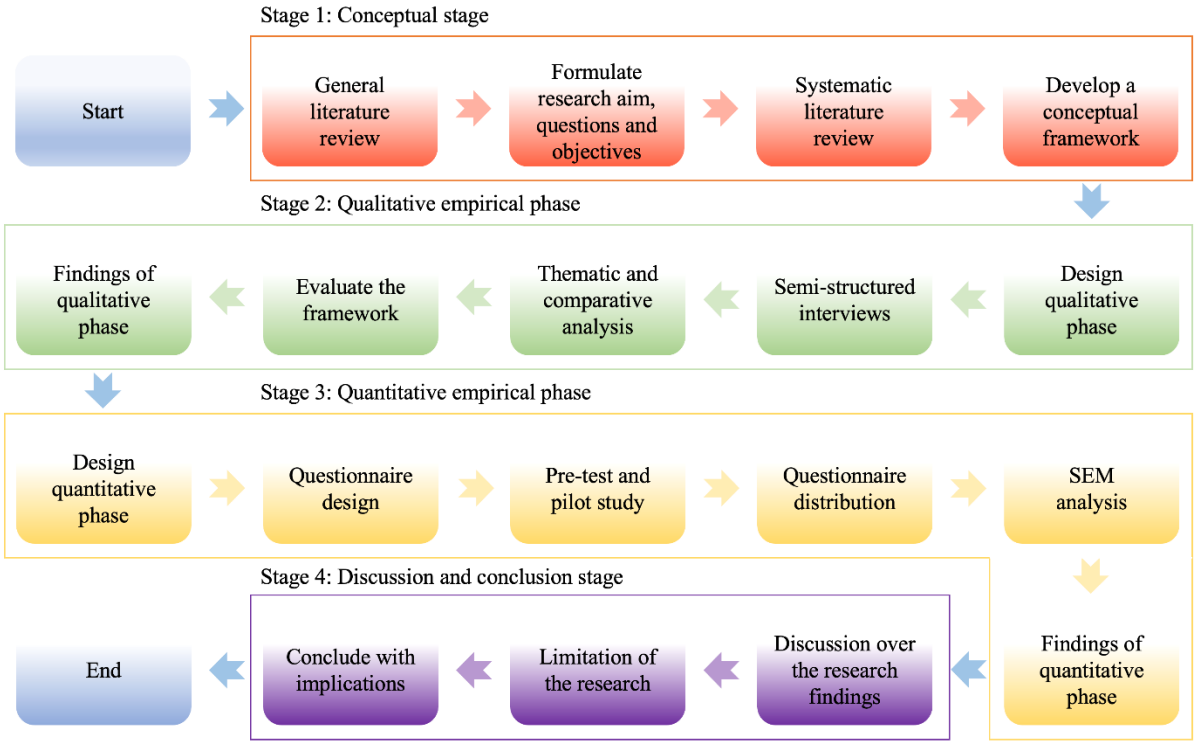


Figure 3.3: The research design of this study

Figure 3.3 presents the research design. The overall research design comprises four stages and the end of each stage is the start of the next stage. The red, green, yellow, and purple colour boxes demonstrate research activities in conceptual stage (stage 1), qualitative phase (stage 2), quantitative phase (stage 3) and conclusion stage (stage 4), respectively.

Stage 1 starts with a general academic literature review, for establishing concrete research questions and objectives. Besides, a wide overview of the subject matter can be obtained. Then, a systematic literature review (SLR) assisted in identifying the key factors affecting knowledge mobilisation in agri-food supply chains, potential boundary-spanning mechanisms, supply chain lean performance KPIs, and to establish research gaps and develop the conceptual KMob framework. The stage 2 consists of research activities in the qualitative phase. Semi-structured interviews served for data collection from the lean agri-food supply chain context and helped to refine and improve the conceptual KMob framework for developing the Empirical KMob framework, on the basis of thematic analysis and comparative analysis outcomes. The thematic

analysis helped to generate important themes together with the comparative analysis which compared themes over various companies and respondents. Evaluation on the conceptual KMob framework was conducted based on the semi-structured interview results in two phases. First, the key factors affecting knowledge boundaries and boundary mechanisms have been confirmed through deeper understanding about how supply chain actors mobilise knowledge (empirical KMob framework). Second, by revising the results through the 15-Point Checklist of Criteria helped to revise the results, thus linking the identified themes to their types of knowledge boundaries and boundary-spanning mechanisms. Following this, with little literature support, research adopted the comparative analysis for confirming the second-order themes identified via thematic analysis. In addition, the framework has been given further assessment using thematic and comparative analysis through identifying a new emergent concept of knowledge mobilisation components. The research has informed findings of the qualitative phase as well as formulated the quantitative phase and its design. The questionnaire survey assisted in obtaining data in stage 3 of the study. A pilot study served for testing the Structural Equation Modelling (SEM) based on discussions with supply chain experts and practitioners in order to develop all of the measurement scales. The analysis has two parts: descriptive analysis and investigation of the impact of KMob on lean supply chain performance using SEM method, then influence of the findings in quantitative phase on those in qualitative phase. The outcome of the quantitative stage is a validated KMob framework. The stage 4 discusses how the conceptual KMob framework has evolved through the empirical KMob framework to the validated KMob framework. It also compares the empirical findings with the existing research outcomes under KMob in lean AFSC. It contributes to the further research areas with theories and managerial implications.

3.6 Research methods

This section explains the qualitative and quantitative methods for data collection and analysis

used in the study and their advantages. Research instruments used in the two phases are seen in Figure 3.4.

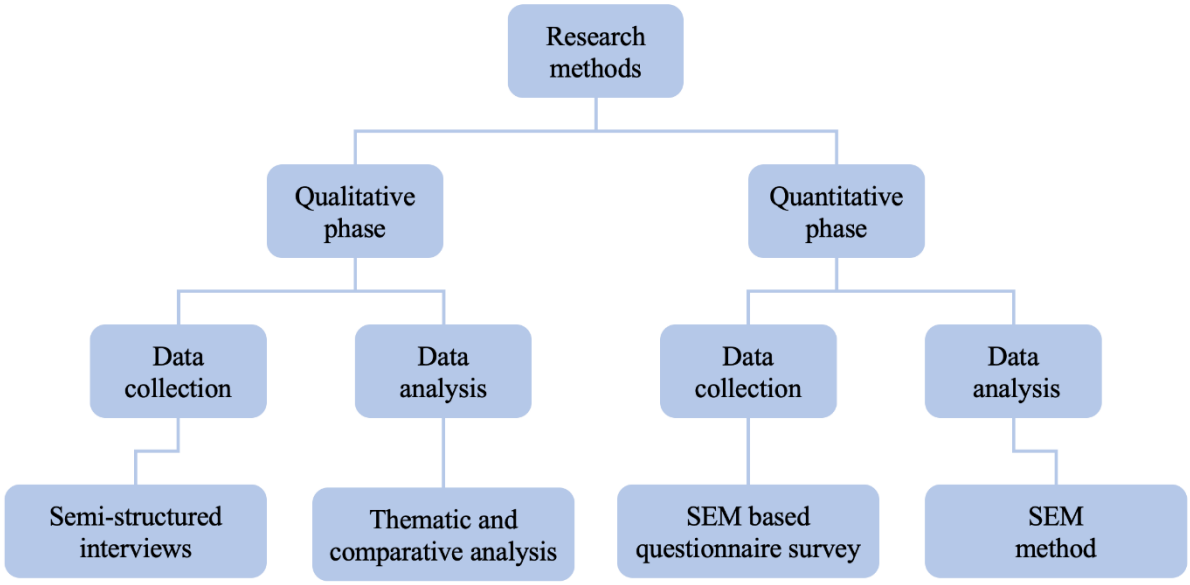


Figure 3.4: Research methods adopted

Robson (2002) explained the three generic forms of interview, namely unstructured, semi-structured and fully structured, which are associated with the response depth to different extents. The semi-structured interview, a qualitative data collection strategy, allows researcher to propose predefined and open-ended questions to informants. It is usually preceded by observation, informal interviews and unstructured interviews, thus researchers can keenly understand the topic of interest and are capable of providing necessary for the development of related and significant semi-structured questions (Cohen, 2006).

The researcher chooses semi-structured interviews as researcher can prepare questions in advance, thus interviewer can prepare in advance and appear proficient in the process of interview. In semi-structured interviews, informants are capable of expressing their views freely in their own terms by open-ended questions and discussions, which encourages two-way communication, to provide reliable, comparable data and deliver new ideas on the topic. In this study, semi-structured interviews can be found in a wide range of positions within

organisations, from junior (devoted to projects) to senior (concerned with business orientation), allowing to investigate different views and thoughts about knowledge mobilisation, as each group of participants has a legal but different understanding of research area. From this point of view, the semi-structured interviews are capable of comparing different ways to view situation as well as developing a more suitable inquiry line for finding the emergent themes during interviews (Easterby-Smith et al., 2012).

The study adopted thematic and comparative analysis for analysing data obtained from semi-structured interviews. Thematic analysis and comparative analysis mainly worked for within-case analysis and cross-case analysis, respectively. Thematic analysis can serve for qualitative data examination, paying attention to the unison of themes and patterns. Comparative analysis is closely association with thematic analysis. It can help to contrast and compare different people' data until researcher identifies all issues (Tharenou, Donohue, & Cooper, 2007). In this study, a combination of these two methods was appropriate for the qualitative phase because they were not only to confirm existing themes, but also assisted in identifying new themes emerged from coded data (Dawson, 2002; King, Horrocks, & Brooks, 2018).

Non-probability sampling is a type of sampling technique where the probability for choosing each individual from all cases is not known in advance (Sharma, 2017). Researchers could choose samples using a variety of techniques based on their own assessment (Saunders et al, 2019). Non-probability sampling includes five sampling strategies, namely, quota sampling, purposive sampling, snowball sampling, convenience sampling, and self-selection sampling. It is connected with qualitative research frequently (Taherdoost, 2016). In accordance with the qualitative approach used in this research, non-probability sampling was chosen to address the research questions and objectives and to obtain theoretical understanding.

Quota sampling primarily serves to ensure that particular groups are fairly represented in the study by allocating a quota (Serkaran and Bougie, 2016). In order to ensure that the distribution

of characteristics in the entire sample matches that of the wider population, participants are chosen based on predetermined criteria. However, this arrangement of quota sampling also puts validity at risk because the researchers are more focused on finding respondents who meet the requirements than on the development of a theory. Additionally, knowledgeable participants may be ignored because the researchers have already interviewed the required number of suitable informants. Convenience sampling might be viewed as the least rigorous sample technique because it entails choosing participants that are easiest to be obtained (Saunders et al, 2019). Self-selection sampling is appropriate when the researchers intend to let potential participants take part in the research depending on their preference. The most important factor was that research subjects volunteering to participate in the study rather than being solicited by the researcher directly (Sharma, 2017). Thus, self-selection sampling provides advantages in cost control at a low level, but it is challenging to choose appropriate participants because the participants are self-selected.

Considering during the exploratory phase, non-probability sampling method is the most effective one. Thus, this study employs a combination of two non-probability sampling techniques: purposive sampling and snowball sampling in qualitative phase. More details about these sample techniques will be discussed in section 4.2.

A survey instrument, which is usually the questionnaire, served for collecting data in the study in the quantitative phase. In this study, questionnaires were distributed to obtain the opinions from large group of respondents - AFSC experts and workers who play a key role in knowledge mobilisation crossing boundaries. In addition, the questionnaire survey is appropriate to validate the factors for each boundary-spanning mechanism that promotes the development of knowledge mobilisation process. In general, questionnaire survey is good to use because it can reach many respondents more easily. To support the data collection, a combination of convenience sampling and snowball sampling techniques have been used in this study. To start

with, a list of 16 organisations, as partners on the consortium of an EU Horizon 2020 project, RUC-APS (Risk and Uncertain Conditions for Agriculture Production Systems), were approached for convenient purpose, because the researcher belongs to a partner on the RUC-APS project and has access to other partner organisations. Subsequently the study employed the snowball sampling technique, also a non-probability sampling technique obtaining subsequent respondents based on initial respondents' information. At first, the researcher conducted well-structured interviews with the 16 individuals from partner organisations and the questionnaire was completed by them. Then through personal contacts recommended by the partner organisations following snowballing, more potential participants connected with agri-food chain activities were identified. In sum, the snowball sampling has great influence in helping to identify appropriate participants who can provide adequate data sources (Saunders et al., 2019).

Structural Equation Modelling (SEM) is a multivariate method used for testing the causal relationships between different constructs with multiple measurement items (Tabachnick, Fidell, & Ullman, 2007). The main advantage of using SEM is that it allows simultaneous analysis of all the variables in the model instead of separately. In other words, it gives a universal and simple statistical analysis framework including many previously used multivariate procedures, such as factor analysis, regression analysis, discriminant analysis and canonical correlation (Hox & Bechger, 1998). Then, SEM has a representative character, i.e. it uses 'latent variable', which can not be found in other analysis methods. Latent variable are constructs, thus are not observable. For instance, in this study, KMob and lean performance are latent variables, and they cannot be reliably and validly captured by single indicators, which is unrealistic. These complex variables shall be captured by multiple indicators (Jeon, 2015). Therefore, SEM is considered as an appropriate method for measuring equations and capturing latent variables.

In order to study a general phenomenon or a fact, selecting the appropriate representative samples from the overwhelming data source is crucial for research. There are two main sampling categories: probability sampling and non-probability sampling. Probability sampling is mainly used to answer research questions that aim to reflect a phenomenon from a general or average view. Saunders et al (2019) stated that probability sampling might provide an accurate result however might represent the most costly sample in terms of time and energy.

While non-probability sampling tries to explain the result from specific sections, or the researcher already has in mind what sample groups are involved in causing the phenomenon (Saunders et al, 2019). According to Saunders et al. (2019), the research questions influence the sampling technique, thus based on this concept, non-probability sampling is more suitable for this study. Also, this study is aimed at a target population of agricultural professionals who have been involved in knowledge mobilisation activities. There are no formal and reliable data on this topic available, thus a non-probability sampling technique was used and the sample was selected in a non-random manner.

Purposive sampling refers to the occasions when the researcher should select specific cases and groups that the researcher is expecting to gain particular information from, which can also be referred to expert sampling and judgement sampling. Purposive sampling is also a sampling technique that allows the researcher to find individuals with specific features to form specialised sample groups following his/her own judgment and intention, to achieve certain research purpose, objectives, and answer the research questions (Saunders et al, 2019). As per snowball sampling, it obtains feedback from respondents that are referred by the initially chosen participants. This sampling technique is often being adopted in cases which are difficult to select potential participants from desired population pools. Under this case, not only the sample size could be maximised, the quality of the empirical study could also be ensured (Taherdoost, 2016). In quantitative phase of this study, purposive sampling and snowball

sampling are used. More details about these sample techniques will be discussed in section 5.2.2.

3.7 Research validity and reliability

For the examination of empirical research quality, four tests have been commonly used in social science research, namely 1) construct validity, 2) internal validity, 3) external validity and 4) reliability. As found in research by Yin (2017), empirical research takes construct (objectivity validity) as the most important standard. Under construct validity, results will not be biased by selective data. In this study, objectivity is built with different strategies. Firstly, multiple sources of evidence were used, for example, both qualitative and quantitative data collection techniques are used. Secondly, the semi-structured interview participants had the chance to review reports and to express their opinion on the content. Thirdly, this study identified operational measures (lean performance) and evidence needed to be collected. Internal validity is concerned with establishing cause relations across the findings and ensuring there are no other plausible alternatives. In the study, internal validity gives one concern about if lean has been achieved because of the proper performance relationships explained. For guaranteeing the internal validity, a group of expert participants was deployed, with the purpose of obtaining their different opinions. External validity is concerned about whether the findings can be translated to other settings. To some extent, external validity is more critical than internal validity. This study deploys analytical generalisability as well as uses a theoretical framework to perform further comparisons and generalisations. Research reliability exhibits an association with the reproducibility of research findings. The purpose is to ensure that later researchers who perform research following same procedures under same settings and conditions will obtain the same findings. It is worth mentioning that the 15-point checklist of criteria for good thematic analysis has been chosen in this study (Braun & Clarke, 2006; Easterby-Smith et al., 2012; Yin, 2017).

3.8 Research ethics

Ethics critical for research conducting, are the standards of research behaviours associated with the rights of people who are, or impacted by, the subject of the work (Saunders et al, 2019). This study followed the required standards of the ethical guidelines published by University of Plymouth. Interviews and survey both considered the relationship between the researcher and the participants and this required a high degree of sensitivity on the part of the researcher not to use the existence of such a relationship or the nature of a 'power relationship' to compromise the participants in any way (Saunders et al, 2019). Therefore, careful planning of interviews and survey rollout was necessary, and this required the researcher to remain as detached and objective as possible. Additionally, in order to obtain the honest answers from respondents, the researcher made sure in the cover letter that their responses and private information would be kept confidentially and would not be revealed or be made for commercial purposes. Ethical consideration of this study followed the ethical principles of research conducting with University of Plymouth ethical approval.

3.9 Summary

Chapter one gave a critical analysis on the existing research methodological models, aiming at developing a proper methodology to fulfil the objectives of this study. It first explained many research philosophies, made effective choice about study nature and character, together with the questions put forward. It was found that the epistemology of interpretivism exhibited the largest relevance to the study nature. This study commenced with inductive reasoning given that empirical knowledge was little and theories about boundary-spanning knowledge mobilisation was deficient, and then deductive reasoning. Furthermore, the research strategies, semi-structured interviews and survey questionnaire were selected for data collection from respondents. Then, qualitative and quantitative data were analysed by the established data

analysis tools and techniques. The chapter finally explained research validity and reliability issue. Figure 3.3 presents the research design.

Chapter 4 Empirical stage one: qualitative data collection, findings and analysis

4.1 Introduction

Discussion regarding empirical data sampling, collecting and analysing in the qualitative phase of this investigation are offered within this chapter. This qualitative empirical phase answers first two fundamental research questions by identifying the key factors to influence knowledge mobilisation and their interactions to overcome network boundaries. Furthermore, this chapter illustrates how various the utilization of data collection and analysis can be to answer the researching questions. More critically, the utilization of the semi-structured interviews for data collecting is described. Sampling technique applied in this study is discussed in section 4.2, followed by the design of interview template and the conducting of interview systems in section 4.3. After that, the qualitative data analytical approach with thematic analysis method is explained elaborately in section 4.4. The empirical findings from comparative analysis are presented and explained in section 4.5.

4.2 Sampling strategy

There are two types of sampling strategies: probability sampling and non-probability sampling. During the exploratory phase, the non-probability sampling method is the most effective one. Thus, this study employs a combination of two non-probability sampling techniques: purposive (or judgemental) sampling and snowball sampling (Saunders, Lewis, & Thornhill, 2019).

During the purposive (judgemental) sampling phase, participants were selected based on pre-defined criteria that enable the researcher to answer the research questions. Purposive sample size depended on the time and resources available, as well as the objective of the study. In terms of the number of respondents needed in the sample, Guest et al. (2006) explained that, as the research which aimed to understand the commonalities of a rather homogenous population, 12

in-depth interviews should be enough. In addition, Saunders et al. (2019) suggests a continuous collection of qualitative data by conducting additional interviews should proceed until the data saturation is achieved. And there is also a statement that there is no need to premating the sampling size in qualitative study because they can be discovered while conducting the fieldwork.

Another common sampling technique is snowball sampling. First, the informants have been established through the purposive sampling, and then explore their own social connection in order to introduce the researcher to other possible subjects of interest with valuable information to provide for the study. Hence, snowball sampling method is commonly employed to clarify and recruit any hidden population (Creswell & Poth, 2016; Mack, 2005). Therefore, in this study purposive sampling method assures sufficient representation of crucial themes. Then at the conclusion of the interview, each respondent was asked if they had known someone that would be suitable for a similar interview or knowledgeable about the phenomena. Finally, recommendations will be taken supervised by understanding of the research field.

In this study, the unit of analysis is an organisation, and an organisation referred to AFSC player. The embedded units were individuals in a series of organisations. Primarily, organisations were taken in consideration by their sizes – small size, medium size and large size. The European Commission formulates that the organisation size could be classified by the number of employees, annual turnover as well as the summary balance sheet. Therefore, the size referred in this study was measured by the number of employees because they could easily access the organisational knowledge, to which employees contributes the most. Organisations with employees less than 250 are classified as SMEs, and large organizations otherwise. SMEs were classified furtherly as micro-, small- and medium-sized enterprises (see Table 4.1).

Table 4.1: SMEs classification

Company category	Staff headcount (<)	Turnover flow (≤)	Balance sheet total (≤)
Micro-scale	10	€ 2 m	€ 2 m
Small-scale	50	€ 10 m	€ 10 m
Medium-scale	250	€ 50 m	€ 43 m

The selecting criteria for both semi-structured interviews in this chapter and questionnaire survey in chapter 5 were that the companies:

- Should be from AFSC industry (section of the analysis in the paper) and the contact source should be from management (embedded section of the analysis in the paper)
- Employed best management practices in knowledge and/or involving in different kind of knowledge management activities
- Hit the criteria of the SMEs definition set by European Commission for the agri-food industry
- Gave their informed consent as a compartment of the semi-structured interview as well as the questionnaire survey sessions

This study has benefited from the RUC-APS project, under the Horizon 2020 Programme (H2020-MSCA-RISE Award No. 691249) funded by European Commission. Since October 2016, the researcher has been recruited in the RUC-APS project (€1.3M). The project is about the Risk/Uncertainty/Collaboration within Agriculture production systems. The researcher's role is to work on the work-package 2 led by Plymouth Business School to develop an innovative knowledge mobilisation framework for food supply chains. The researcher has completed secondments and collected empirical data from all other partners in five countries across Europe, including Spain, France, Italy, and South America (Chile and Argentina). In order to make sure the commonalities of the collected data, the sampling process was accomplished over a time period of 18 months. Taking their position in the AFSC into

consideration, the companies were chosen in this study (i.e. agriculture, food processing and food distribution). The agricultural industry mainly participates in crop production and livestock farming activities. Organisations in this agricultural industry chain can either sell their products to the product process industry, or to the local industry as the form of animal feed, or to the distributors including exporters, wholesalers and retailers, or directly to food catering and final consumers, or maybe to the alternative markets as a kind of biofuels. In this stage, many other different actors are involved in the product innovation. Usually, these actors are not the original stakeholders of the organisation, but more novel, like research institutions, universities and school, and social communities. The food processing industry includes various organisations along with activities, such as shattering or dewatering relating to fruit and vegetables, culling, disassembling and storing relating to livestock, or boiling, roasting, braising, baking, fermenting relating to coffee. In most cases, the final part is always packaging the agricultural products, and then deliver them to the scheduled customers. This industry is also related to marketing and novel product developing activity. The distribution process (wholesale/retail) is the primary channel for the agricultural products to be sold. Since the distribution process has a strong direct contact with consumers, the promotion of the food products is another vital activity to proceed for the agricultural products (Cagliano, Worley, & Caniato, 2016). The sample comprising a total of 34 individuals from 15 organisations, including agriculture companies, food processing organisations and distribution firms (see Table 4.2). Table 4.2 listed the organisations and interviewees involved in this study, the position in AFSC and the role of interviewees' job. The population of staff is calculated by summary statistics on the official website or obtained hard drive copy. The names of the companies and organisations retained anonymous under the guideline of the research ethical aspects (see section 3.8).

Table 4.2: A background of the companies and interviewees

SN	Main role in AFSC	The number of employees	Ownership	Interviewee' position	Collected data	In-site tours (Yes/No)
1	Farmer	20-30	Privately-owned	Owner (5) Middle level manager (3)	Eight semi-structured interviews	Yes
2	Research institution	100-200	Publicly-owned	Lab manager (1) Supervisor (2) Director of information technology (2) Data officer (1)	Six semi-structured interviews	Yes
3	Processor	80-100	Privately-owned	Director (2) Operation manager (2) Marketing manager (2)	Six semi-structured interviews	Yes
4	Wholesaler	30-50	Privately-owned	Owner (1) Director of marketing (2) Operation manager (1) Co-owner (1)	Five semi-structured interviews	Yes
5	Retailer	80-100	Privately-owned	Director of knowledge extension (2) Director of operation management (1)	Three semi-structured interviews	Yes
6	Government body	15-20	Publicly-owned	Director of agriculture department (1) Project manager (1)	Two semi-structured interviews	Yes
7	Exporter	100-120	Privately-owned	Owner (1) Director of operation management (1)	Two semi-structured interviews	Yes
8	Seed provider	20-50	Privately-owned	Director (1) Marketing manager (1)	Two semi-structured interviews	Yes

Managers referred in this research were categorised accordingly by their position as below:

- The persons on top managerial level who are responsible for operational management, strategic policies and they may be expected to have an overall strategic insight. Such as CEO/Director/Managing Director/ Board of Executives, they are the top level of interviewees as they have the overview of the companies' operations and are most likely to be knowledgably regarding the mobilisation initiatives.
- Mid-level management employees include Project Director/ Senior Manager /Project Manager/ HR Manager/IT Manager /Quality Manager. These employees were chosen because they are involved in the daily business operation and have in-depth knowledge of the industry. Middle managers were usually in charge of the knowledge conversion processes or learning processes of work teams. They also are the key factors for successfully implementing the knowledge management initiatives and achieving a desired strategic outcome of an outstanding performance (Purcell, 2003).
- Junior-level management are the direct supervisory roles with specialised division of labour.

These employees are required to share their expertise. The semi-structured interviews and the questionnaire survey could cover all the viewpoints approached by sampling objects from all the interviewees. Numerous aspects from culture, hierarchy and features are approached by the diverse range of interviewees.

4.3 Data collection through the semi-structured interview

In section 3.6, the semi-structured interview is conducted for qualitative data collection. The justification for the choice of the method is described in 3.6. In the semi-structured interview. This research follows an interview template which includes a series of questions of interest, however, the selected questions would be slightly different according to interviewees'

knowledge and experience. It means that some questions would be neglected if the interviewees lack of the knowledge and experience related to the topic. The sequence of the questions may also be changed to keep complying with the specific conversation. Furthermore, further questions might be posed to help in investigating the research questions and objectives considering a particular organisation daily event can be diversified.

The main focus of this study is to understand how knowledge is mobilised through a variety of networks along with their linkage and develop a KMob framework. In the study, the research mainly evaluated the KMob framework on different stages by examining the validity of the existing compartments and introducing new compartments or eliminating redundant ones. This study was accomplished through the process of reviewing the related literatures and examining the outcomes by conducting a series of semi-structure interviews. In addition, this study shed new lights on multiple practices about KMob from different industry practitioners.

There are 15 companies (as shown in Table 4.3) representing agriculture, food processing and distribution industries in AFSC. The companies' operations, business, type, scale, the level of management and job role are shown in Table 4.3. A pilot study was conducted in February and March 2017, 7 professionals and managers from 4 agricultural organisations and accompanies were interviewed, and the objects were selected basing on the geographical convenience and availability. The correction and modification to the interview template were minor according to the feedbacks from the pilot study.

Table 4.3: Summary of the companies participated in the interviews

Category		Company size		Interview with	
Farmer	8	Medium-sized	19	Top managerial level	25
Research institution	6	Small-sized	15	Mid-level manager	6
Processor	6	Experience		Junior-level manager	3
Wholesaler	5	More than 5 years	5		
Retailer	3	More than 10 years	10		
Government	2	More than 15 years	9		
Exporter	2	More than 20 years	10		
Seed provider	2				

The interview questions were set to answer the first two research questions. The interview template includes 16 questions classified under the topic of factors to affecting KMob and boundary spanning mechanisms (boundary spanners, boundary objects and boundary interactions) to enhance KMob competence in order to improve organisational performance.

The accomplishment of the interviews took over 18 months from April 2017 to August 2018. The consent in paper form was completed by each participant to acknowledge that participation was voluntary. Informed consent was obtained from the interviewees to record each interview session. The interviews were recorded accurately and stringently to avoid any information loss, so that the information could be later analysed. The researcher also conducted several underline interviews at participant's workplace and each interview lasted for about one hour according to the interviewees' schedule and time availability.

4.4 Thematic analysis and findings

Thematic analysis was utilised to analyse qualitative data collected from the interviews. Thematic analysis is a foundational approach for qualitative analysis and a method for clarifying, analysing and reporting themes. Analysis is a recursive process as constant moving backward and forward are needed throughout the phases rather than a linear process where the working phase simply moving from one to another (Braun & Clarke, 2006).

In the next section, the process of thematic analysis will be investigated and the analysis findings will be also discussed in detail in order to refine the conceptual KMob framework using thematic analysis.

4.4.1 Thematic analysis process

The thematic analysis can be separated into five main steps (see Figure 4.1): transcribing steps, editing steps, coding steps, categorising steps and modelling steps. In this study, to avoid any omissions from the interview participant response, the audio files were verbatim transcribed. Transcripts were carefully edited to avoid irrelevant or duplicated terms.

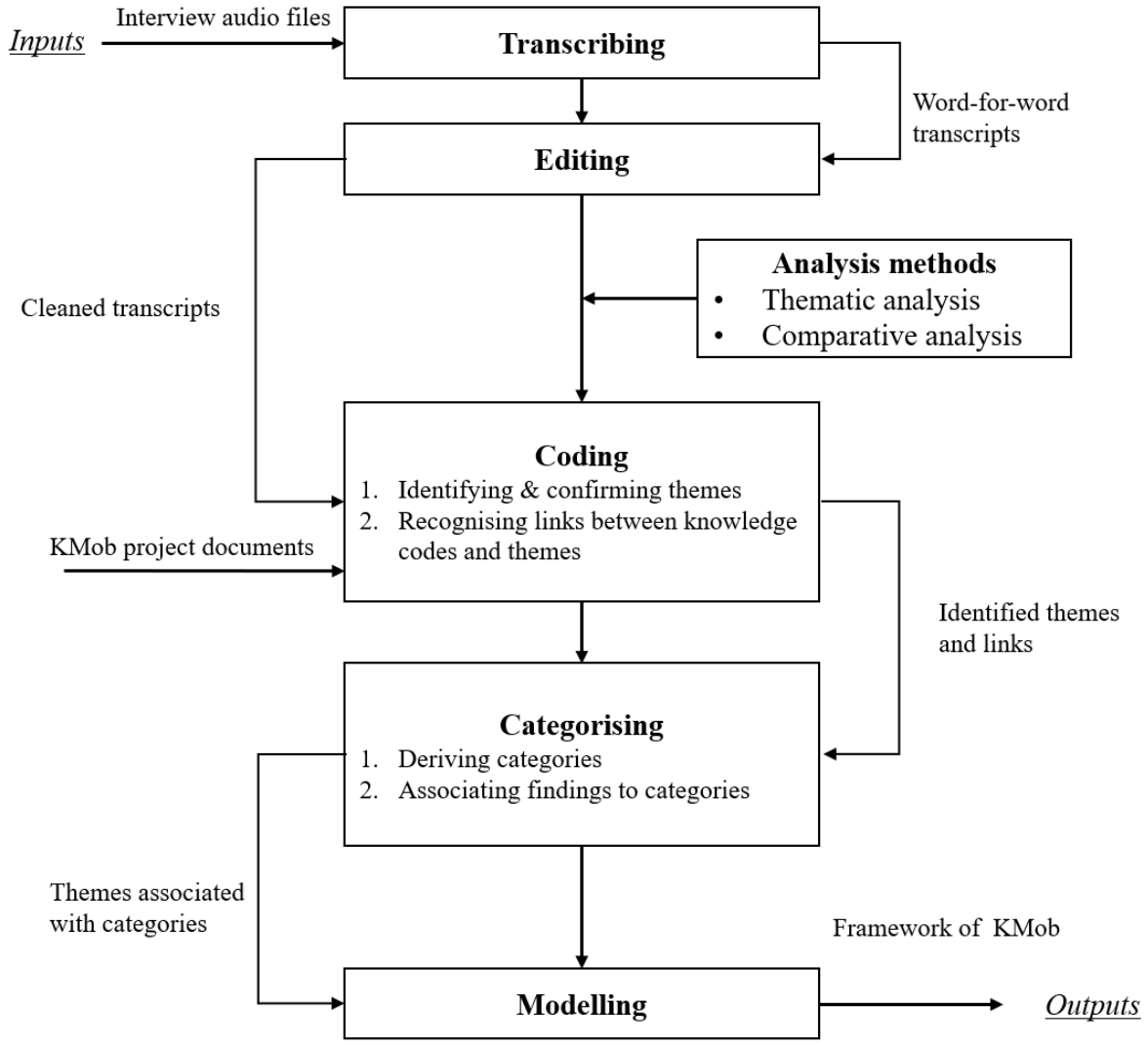


Figure 4.1: Thematic analysis process

Once the data has been collected and the list of idea have been simulated, then the coding procedure would be initiated. In addition, the QSR NVIVO was applied to proceed the following procedure of the thematic coding approach. This was achieved by titling and grouping selections from the text containing every item. According to Braun and Clarke in 2006, it is crucial to code the most different possible items, so that the researcher can devise a lengthy of terms since it is impossible to predict the next spot of interest. Then, the wider perspective analysis is required to identify themes such as sorting and organising of the diverse relevant codes. This process was completed as a series of potential topics and sub-topics had been built. A thematic network was designed to evaluate whether the collated code items for

each topic possess the potential to form a coherent pattern, or if the link between individual theme and the entire dataset is valid. After finishing this step, the researcher managed to design a series of topics. Finally, the KMob framework was upscaled to the evaluation stages by adding the empirical results in the system.

The researcher achieved to identify multiple topics by considering the three different stages underlined by Horrocks, King and Brooks (2018):

- Descriptive coding process (first-order codes): the researcher collected the transcript data from the interviews to allocate the descriptive codes and answer the questions in the study.
- Interpretative coding (second-order codes): the researcher groups combined the descriptive codes sharing common meanings in order to generate an interpretative code to capture this.
- Defining the overall theme (the final aggregate dimension): a number of overall themes that can characterise key notions in the analysis are identified by the researcher.

There are several ways of defining overarching themes. Key advice for it is to give examples from the original data set and acquire specific quotes from the interviews transcribed to categorise themes. These quotes should possess abstract content short quotes to simplify the understanding of the topic and the interpretation. Moreover, the second-order terms were noted using first-order codes and amplified into the aggregated dimension to find network boundaries issues and the ways in how knowledge is mobilised across AFSC as well as the factors to influence knowledge mobilisation. Finally, the framework was built in the modelling process, by integrating and summarising all the findings above.

4.4.2 Thematic analysis findings

The empirical findings will be discussed in this chapter based on the data collected through semi-structured interviews regarding the 15 companies. These will cover the discovery of

boundary penetration, that is, the factors affecting knowledge mobilisation, the evaluation of boundary spanners, boundary objects and boundary interactions. In chapter 2, factors affecting knowledge mobilisation were partially identified, some factors which cause knowledge mobilisation capabilities that companies should employ to improve the transferring and sharing of knowledge, will be identified from the data which have not been stated in the literature. Furthermore, the validity of the conceptual KMob framework is assessed based on the empirical findings.

4.4.2.1 Identifying key factors affecting knowledge mobilisation in supply chains

Aiming to build reliability and validity in analysis coding, the research included three independent reviewers in the data analysis stages (Alhojailan, 2012).

The first reviewer is an academic researcher in an agricultural college in Southwest England. This college is the largest education and training provider in the educating field with over 15,000 learners each year. The reviewer has led several dedicated agricultural engineering projects, and he has been a consultant in multiple large-scale agricultural projects.

The next reviewer is a marketing executive at the foodservice company in cheddar supply chain in the UK. He can access considerable amount of market research information. He was assigned as one of the agricultural project managers at regional level. He also has been involved in many businesses since he has been in top level of management for ages.

The third reviewer is a station manager in a biofuels supply chain. Normally, the waste and residues from agriculture can be used as a source of bioenergy. The station is located in the Southwest of England. The manager has a close relationship with government since the growth in biofuels is supported through government legislation and subsidies at present.

The results illustrate the role of the organisations and main knowledge channels within the network. It also identifies the function of public areas in trying to play the part of knowledge brokers or intermediaries. The interviewees explained one of the biggest issues to knowledge

brokering lacking the knowledge about the working process, what contextual factors influence the effective brokering (Ward, House, & Hamer, 2009). This has been achieved by most of the participants. For example, the academic researcher was quoted:

"Agricultural experts acquire knowledge from schools, colleges and research institutions and circulated through the global network of specialised talents, institutions and publications. However, farmers usually acquire specialised skills by constant practice, trial and experience. They learn what they know from the social and peer worker groups. Therefore, the problem here is they may listen to advice about agriculture politely but still never change their way of farming."

In AFSC context, knowledge brokering is often presented by individuals with hybrid professional jobs, such as the marketing executive may span the line between the management and the marketing. The marketing executive stated:

"I don't think it's necessary for knowledge brokers to dedicate all time to the task of professional skills brokering because brokering is a huge time consuming programme. Also not everyone is equal to the position, the person who should have good interpersonal communicational skills and personal charisma such as flexibility, patient, curiosity and confidence."

A biofuels chain is exploring the issue of simultaneous improvement of the environmental and economic sustainability of the agricultural food suppling chains. However, the lack of the exchange of bioenergy knowledge among farmers has been regarded as the key question to sustainable agricultural development. The station manager claimed:

"Information have been largely confined to the public domain and obtained through Ministries of Agriculture. Farmers pay little attention at both economic and environmental aspects of the chain as well. Thus, farmers will be in need of local supporting teams acting as icebreakers between the specialised knowledge and knowledge partners in technology transfer. The success

of the implementation of novel agricultural concept and technics relies on the successful communication between the brokers and the farmers."

The researcher introduced a new concept or technology about farming which included three types of emerging boundary relations, the relations of the government organisation, agriculture experts and farmers: (1) Team work: it was observed at the line between the government organisation and agriculture experts with bilateral expansion of work jurisdiction; (2) Neglection: as the weakest population, farmers were usually neglected by the government organisation; and (3) Strain: it was observed at the separating line between agriculture experts and farmers, with lack of control, increased interdependency and working fragmentation. Therefore, there is a need to focus on the analysis of the boundaries involved in the interaction of occupational population.

A structured mobilisation of knowledge framework is considered as a key part to overcome network boundaries to show how knowledge is mobilised across organisations to support decision making in the agricultural food supply chain. This kind of model allows the identification of themes to be linked to the related boundary interactions, all the topics were displayed in the original constructing process the conceptual KMob framework system.

The participants explained the challenges to construct networks and develop the formation of knowledge mobilisation in agri-food supply chain. The first challenge was about the lack of the relative stability of the environment to build trust and cooperation which fosters knowledge sharing. An environment of trust was one of the vital compartments in implementing sharing the expertise. Moreover, the trust could also improve an inspiring spirit and the willingness to share expertise and significantly increase the efficiency of the company in turn (Faisal, 2010). However, the results revealed many organisations have still not created the trust environment. One of the respondents stated:

"Take the internal and external barriers into consideration, the development of trust and stable

working relationships are hindered. So far, I would say the primary problem is specialized knowledge sharing. I hope the staff can sit and discuss on a project. Sometimes the managers can take care of staff personal issue. I believe with this close relationship, our relationship would be solid and harmony and nothing can stop us from knowledge sharing."

He also added in this regard:

"I think if we can get support from top level of management, it's definitely helping us with expertise mobilisation."

As mentioned by many interviewees, successful communication and team work in the chain were determined by the previous relationships between chain members, also in many cases, farmers, sorting and packaging stations and distributors had spent years working as a team in the same practice. But a further challenge here is that participation in the collaborative is still considered to need to be improved, where several chain members were relatively impractical to their practice roles:

"I think teamwork and communication offered us a better team. It definitely helped us to find our way of working as a team, to build on our strengths and to correct our weaknesses. One of the economical friendly methods to share expertise in an organisation should be mentored. However, I would say many organisations have not established formal mentoring. This formal mention needs to be recognised by top level of management."

In the context of this study, knowledge mobilisation between network members, all of which were supposed to learn from each other. The are several forms of securing a wider participation were found to have been used, for example:

- Organising workshops so that everyone can discuss their experiences and best practices relating to the theme topic.
- Peers assisting to who struggles with the topic discussed.
- Make an invitation to key workers to make presentation and let staff discuss with them.

Another concern is the role of organisational structure as a factor which possibly would prevent the boundaries destabilisation and inhibit the share of knowledge between the networking members.

The chief executive claimed:

"Organisations interviewed should sponsor creating a looser organisational structure since it can improve the performance of employee involvement in the share of expertise. I suppose that the use of flexible organisational structure may be ranked as one of the most highly recommended approach to knowledge and experience sharing."

Previous research had suggested that formal and centralised structures tended to have an adverse effect on share of knowledge across boundaries. A more negotiable and informal structure could promote the knowledge mobilisation success, including incentivising changes of behaviours or facilitating leadership (Gold, Malhotra, & Segars, 2001). Similarity, Thompson (2005) presented the research finding that introducing too much control in the group linkage was likely to result in the inhibition of the effective sharing of knowledge. However, loose and informal structures could enhance employees' intension to cultivate a critical attitude towards learning knowledge, facilitate extra- and intra-organisational communication and encourage employees to share knowledge (Thompson, 2005). Hence, a flexible organisational structure is an essential influencing factor for encouraging collaboration and knowledge sharing among network members in the AFSC.

However, the director of communication office commented:

"Until now, many organisations still have a vertical hierarchical structure where skill talents is directed from the top management, which limits sharing mobilisation between employees or between employees and managers."

At the conceptual stage of this study, the factors affecting the knowledge mobilisation has not been systematically classified. Through newly emerged themes from interview data, current

findings discover that, to achieve a successful knowledge mobilisation process, political involvement, the level of authority, organising structure and culture and technical maturity should be fully considered when implementing boundary spanning mechanisms.

The findings suggest that knowledge brokers play a crucial role in integrating internal and external resources, transferring tacit knowledge into explicit knowledge; this must be assessed and uploaded to the appropriate knowledge bases in order to guarantee knowledge to be useful. Following that, it becomes imperative for important network participants to get involved in the networks and use knowledge in their decision-making. For example, nowadays retail power has been considered as a threat to the supply system. The expectation of retailers for cheaper pricing, guaranteed levels of quality and on-time delivery is perceived to have the effect of restricting profit sharing through the chain. Farmers in particular were seen to be particularly vulnerable to this chain because of the disparate, often uncoordinated nature of the farm base. This means that to make farmers' voice heard in this relationship, they had to build a concentrated organisation in order to resist pressure, and flexible enough so that they could best adapt to changing constraint; Farmers also saw political intervention to protect their rights. The results of this study are not only support knowledge brokering support could be an important factor to influence knowledge mobilisation, as well as the policy and regulation. For example, when environmental issues were considered to be a serious threat, wheat actors expressed alarm at regulations to restrict the application of certain fertilisers; it is not just agricultural or food-based regulations, but other environmental rules, such as waste and packaging requirements, along with labour laws like the working time directive and drivers' hours, are also covered by these regulations.

As with this study, one of the factors to implement effective knowledge mobilisation is the level of authority. For example, to establish governance functions for the top-down monitoring of systems and processes in order to allocate and promote knowledge mobilisation activities is

the main reflection of the level of authority. The role of management and leadership is concerned with the establishment of governance functions. From this study, the findings show the high failure of knowledge mobilisation in agri-food industry is that an ignorance of the nature of knowledge sharing by the top managers and inappropriate identification of influential activities. Thus, enhance the communication among staff, especially senior management is considered to be the centre of knowledge channels activities.

Subsequently, the findings confirm that a well-defined organisational structure is seen to ensure knowledge mobilisation activities. One practical solution is to create cooperation and communication department. The responsibility of this department is to connect various job roles participating in a project, and this is regarded as a crucial link between key decision-makers, stakeholders, participants and resources. For example, from the interviews, one organisation had implemented a project within its structure, which included total quality management, project management office, strategy management office and business process management. This structure addressed concerns about how knowledge could be shared cooperatively across boundaries and how to achieve the highest optimisation of knowledge mobilisation. On the other hand, a poor organisational structure can prevent individuals from sharing their knowledge across boundaries.

The results of this study are also shown the relationship between cultural aspects and their influence on knowledge mobilisation. For example, organisational maturity and cultural typologies can be seen as a foundation when making decisions. Silo mentality is viewed as a hinder since it results in poor transparency in decision-making. Transparency and trust should be fostered by establishing the community of practise that encourages collaboration amongst related organisations. In practical, it is important to provide seminars, conferences and training sessions in order to identify who the knowledge holders are; at the same time, reward and incentive schemes should be used, alongside other knowledge sharing tools.

The findings of this study support the argument that it is necessary for any organisations to exploit emerging technologies to manage their knowledge assets if knowledge-based community is to be successfully established to bring together organisational resources, decision makers and stakeholders. A range of technologies are available to support knowledge mobilisation, such as email, internet, intranet and telephone for communication; database including data marts and data warehousing for storage and retrieval of knowledge; and collaborative computing tools like groupware and electronic brainstorming capabilities. Such technologies make it possible to access knowledge that has been stored, connect sharers and receivers for sharing and collaboration, and support the improvement of business process.

Figure 4.2 shows how key factors were confirmed based on the interview data collected for this analysis. In addition, from the empirical findings, there are various subcategories under each element. They correspond to the conceptual KMob framework in terms of the key factors such as collaboration, network structure, technology and trust etc.

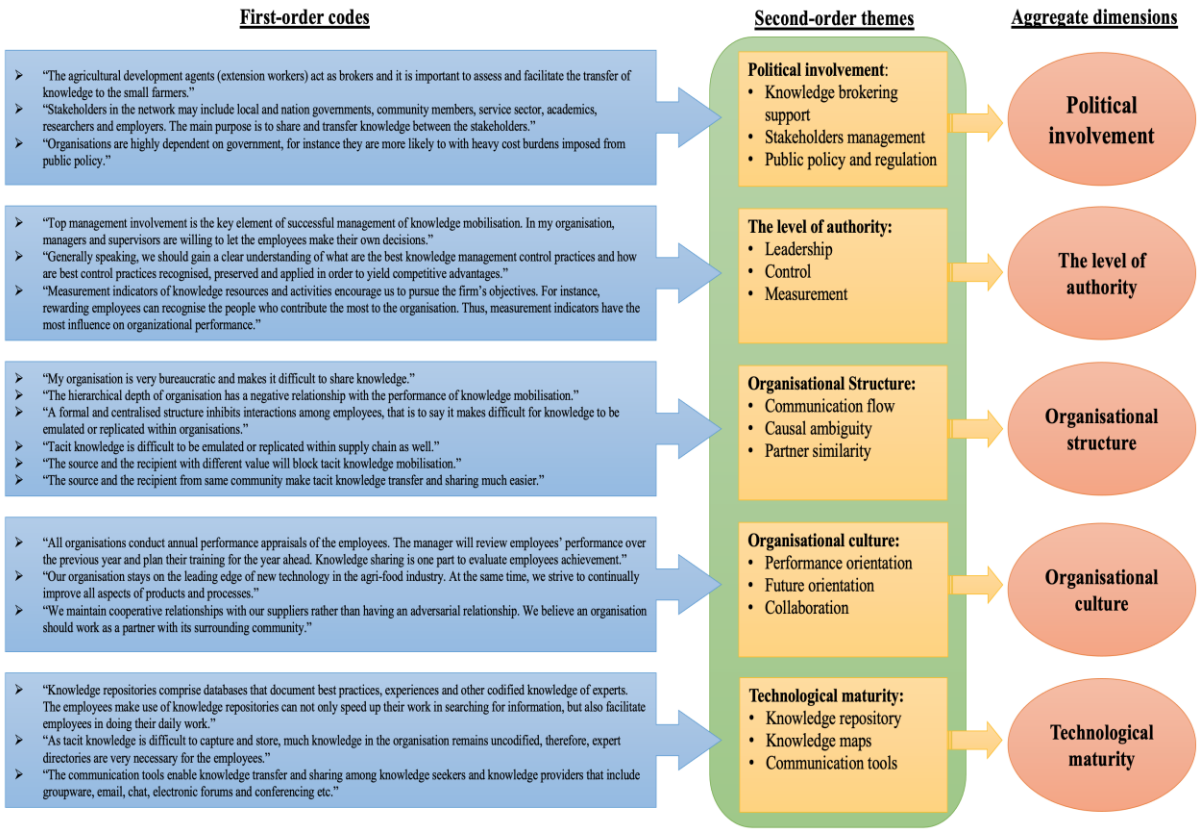


Figure 4.2: Data structure for key factors in KMob

The empirical data was collected across from 15 companies to evaluate the themes set, investigate the credibility of evidence and confirm the empirical findings which were less support from the literature. The scaling approach was adopted to ease the identification of the saturation point where interviews were no longer needed to be carried out. The scales used for thematic analysis are shown in Table 4.4 to demonstrate empirical evidence in each case implementation (Rihoux & Ragin, 2008). Such an approach utilises different markings to represent different means. The number of ticks represent the strength level of evidence. The greater numbers are, the stronger the evidence for the finding in the corresponding factor is. Triple ticks (√√√) represent strong evidence and double ticks (√√) represent moderate evidence. Single tick (√) represents weak evidence and a blank represents no evidence.

Table 4.4: Scales used for comparative analysis

Scale	Symbol	Frequency of occurrence
No evidence	Blank	Zero
Weak evidence	✓	Between 1 and 4 (1≤x≤4)
Average evidence	✓✓	Between 5 and 8 (5≤x≤8)
Strong evidence	✓✓✓	More than or equal to 9 (x≥9)

Table 4.6 describes the experimental evidence utilised to confirm and derive key factors that facilitate boundary spanning mechanisms in supporting knowledge mobilisation across network boundaries. The factors were classified using first-order codes (see column one and column two). Afterwards, the factors (second-order themes) were tested with respect to each case implementation (see column three). The legend was presented in the last row and previously explained in Table 4.5. The aggregate dimensions were finally built based on second-order themes and related themes were categorised into different aggregated dimensions (see column four).

Table 4.5: Key factors affect KMob

First-order codes	Second-order themes	Support from interview cases															Aggregate dimensions
		France				Spain			Italy			Chile		Argentina			
		A	B	C	D	A	B	C	A	B	C	A	B	A	B	C	
"Our supervisor encourages the staff to work as a team. I think everyone in the organisation works well together."	**Collaboration**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	**Key factors**
				√		√		√			√	√		√	√	√	
								√								√	
"The hierarchical depth of organisation has a negative relationship with the performance of knowledge mobilisation"	**Network structure**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
		√		√		√			√		√			√		√	
		√							√		√						
"The knowledge leader must be able to establish an environment in which employees may easily develop their knowledge manipulation abilities, add their own personal knowledge resources to the organisation's pool of information, and have easy access to appropriate knowledge resources."	**Power**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
			√			√		√	√			√		√		√	
			√			√		√	√							√	
"The technology know-how in our organisation is easily transferable."	**Technology**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
		√			√				√			√			√		
		√			√				√								

"My organisation has knowledge worker team to share and transfer knowledge and all employees trust each other."	**Trust**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	**affect KMob**
		√	√		√	√		√	√	√		√	√	√	√		
			√					√					√				
"All employees are given adequate training internally in the organisation."	**Training/**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
	Education	√	√			√		√	√			√		√		√	
			√			√		√	√							√	
"All organisations conduct annual performance appraisals of the employees. The manager will review employees' performance over the previous year and plan their training for the year ahead."	**Culture**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
			√		√	√		√	√		√	√		√		√	
			√			√		√	√							√	
"There is need for more commitment to agriculture. Several elements of commitment, such as loyalty, identification and participation are very important in an agricultural organisation."	**Commitment**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
		√	√	√		√		√	√			√		√	√	√	
			√			√		√	√								

Identified key factors that influencing knowledge mobilisation can provide guideline for organisations to improve their boundary spanning mechanisms. In agricultural food industry, there are many family-owned companies especially for the farmers. A relatively high proportion of self-employment in agri-food supply chains leads to fragmented supply chain.

Trust consists of three aspects namely honest communication, reliance and delivery of outcomes. In this study, trust needs people to be willing to share knowledge, it also depends on how people communicate with each other. Organisations play an important role to drive trust in agri-food supply system, so the changes of attitude of trust could remove the barriers of sharing knowledge. Interviewees mentioned that there was a need to build trust through leadership. They also said that the requirement of empowerment of teams was vital for the agri-food industry because it could enhance the responsiveness of knowledge management activities and further to take efficient decisions.

Technology is a vital part of knowledge mobilisation. Although ICT has been extensively applied for connecting the agri-food industry, the utilization of ICT as a boundary spanning mechanism is still insufficient due to lack of awareness and financial limitation. Moreover, lack of education and training on ICT could also hold back from gaining skills in ICT in agri-food industry. The empirical findings also indicate that most of SMEs have less applications to implement knowledge mobilisation, thus, ICT is not adequately popularized in SMEs to the same depth and breadth as large organisations.

Another factor is training which is provided to the employees either internally or externally. Employees can improve their knowledge through constant learning and training. The findings emphasize that a proper training programme is very important for organisation to enable employees to contribute to knowledge mobilisation. According to interviews, the success of a training depends on multiple influencing factors, which include the knowledge of the trainer,

the training environment, the resources required for the training and the learning ability of the trainees. Thus, proper guidelines given to managers and employees should be cooperative with each other very well.

4.4.2.2 Discovery of boundary spanning mechanisms

There are four types of boundary spanning mechanisms identified from literature in chapter 2 which are included in the conceptual KMob framework. However, empirical findings reveal that only boundary spanners and boundary objects have been used in the agri-food supply chains. Moreover, there is empirical evidence to confirm that boundary interactions should be used to replace boundary practices and discourses.

Collaboration between interconnected networking members can be achieved by appling the boundary spanning mechanisms classified in the following three groups:

- Boundary spanners: people possessing membership in different fields, seek to develop interaction and coordinate practice across chain actors. Boundary spanners is often carried out by individuals with multiple expertise skills, such as agricultural experts may span boundaries between the marketing and the agricultural professions (Ward et al., 2009).
- Boundary objects: boundary objects are inscribed artefacts as forms of texts that in some shape or form capture, codify or represent some other roles; or discourses that shape the dialogue among the experts from distinct domains that allow them to overcome syntactic, pragmatic and semantic boundaries, hence contribute to expertise mobilisation across organisations (Hawkins, 2012; Swan, Bresnen, Newell, & Robertson, 2007). For example, standards for labelling and pro-forma for quality inspection of food have been used to play the role as a boundary in different functional settings teams.
- Boundary interactions among employees from individual domains, these include single

or discrete boundary experience including visits, meetings and delegations and practice-based connections regarding cross-disciplinary projects (Carlile, 2002, 2004).

Boundary spanners is a key component to connecting decision makers to the source of knowledge. Various boundary spanning mechanisms were identified to tackle knowledge boundaries. However, one senior manager pointed out:

"Most local organisations don't hold development research or relevant programmes. They predominantly dependent on their experience acquisition or instructions by government ministries. Thus, it's necessary to combine with skill extension agents to share and transformation of specialised skills."

Boundary interaction activities are regarded to be internal and external. Internal activities include network management and guardienne, engagement of stakeholder, organisations' cultural and social attribution, communicating activities and collaboration. However, external activities include social activities, knowledge brokering along with resources. He added:

"It is important to seek the knowledge we need, but what is the more important is to know how to execute and perform the activities required. So we try personally to construct a link between these activities, but we don't do it systematically."

All respondents highlight the need of boundary objects to transform knowledge from one domain to another. A respondent claimed:

"The object acts as anchors is so important. Managers should pay massive attention to the role of boundary objects and their related interests when design knowledge management practices."

Boundary spanners

Table 4.6 shows how boundary spanners was confirmed based on empirical data collected for this analysis. From the empirical findings, middlemen, contacts, intermediaries or agents who act as negotiators, interpreters, messengers or commissioners between different industries or individuals are all included in boundary spanners. Boundary spanners can exist at individual

levels, organisations levels and structures levels. In agricultural food supply chain, the knowledge brokers are often played by individuals with hybrid professional roles. Table 4.6 illustrates premier examples of brokering contain an information network connecting the agriculture industry to 'county agent' for the disseminate innovations of farmers (Rogers, 2003). Later, consultancy is treated as a delegate for knowledge brokers (Jacobson et al. 2005; Sin, 2008). Recently, in agricultural food contexts, the organisations with professional background act as the expertise brokers, such as the agriculture developing agents (extension workers). Support groups play as brokers between the expertise available and the specialised needs of farming family. It is well known that the performance of novel agricultural technology would rely on the successful communication between the agricultural expertise and the farmers (Islam, 2010).

In addition, the grounds of the role of knowledge workers in the agricultural industry is also discussed in the empirical findings. In the knowledge management literature, the characteristic of a professional is difficult to catch due to the abstractness (Smith et al., 2005). As shown in Table 4.6, knowledge workers are employees who have an in-depth professional background in both in education and experience in a sector. In case of agricultural organisations, employees who working in human resources, IT and systems, brand management and marketing departments are directly involved in the knowledge mobilisation activities.

In terms of HR activities, it encourages interaction among employees. Among all the different HR functions, i.e., selection and recruitment, post design, reward and training can encourage knowledge mobilisation among employees. The role of HR manager is very important since they can build structural relationship between employees. For example, work design such as the job specification can identify barriers from intra-organisational knowledge mobilisation by locating the employees across departments working in the same project. All in all, a series of HR activities (i.e., recruitment and selection etc.) organised by HR managers are used to

involve employees work in a team to utilise knowledge resources.

The role of IT staff in the agricultural organisation is also very crucial. The role of them is to recognise the expertise needs through capturing and sharing explicit knowledge of the organisation by providing mutual access to professional information (Becerra-Fernandez et al., 2004). For example, IT manager helps the organisation to solve lean management issue by developing knowledge repositories to codify the new knowledge, clarify the lean assessment procedure and simplify the process manuals. In other words, this procedure can strengthen the learner's confidence and the skills in a routine job.

The knowledge workers involved in marketing and brand management use new and existing knowledge to disseminate knowledge in the public. In conclusion, the empirical findings support the role of knowledge broker is very essential in an organisation, and the respondents selected criteria especially knowledge workers are reasonable.

Table 4.6: Empirical evidence for supporting boundary spanners

First-order codes	Second-order themes	Support from interview cases															Aggregate dimensions
		France				Spain			Italy			Chile		Argentina			
		A	B	C	D	A	B	C	A	B	C	A	B	A	B	C	
"The agricultural development agents (extension workers) act as brokers and it is important to assess and facilitate the transfer of knowledge to the small farmers."	**Knowledge broker**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
				√		√		√			√	√		√	√	√	
								√								√	
"Stakeholders in the network may include local and nation governments, community members, service sector, academics, researchers and employers. The main purpose is to share and transfer knowledge between the stakeholders. All stakeholders in the chain are the knowledge worker."	**Knowledge worker**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
		√		√		√			√		√			√		√	
		√							√		√						
"Organisations are highly dependent on government, for instance the government is more likely to give some useful information". "Periodic hiring of ex-government officials is widely applied in most organisations because they have the most current knowledge of impending policy changes."	**External facilitators**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
			√			√		√	√			√		√		√	
			√			√		√	√							√	
						√											
"Some organisations are unable to share knowledge effectively because of a lack of commitment of top leadership."	**Managers in an organisation**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	**Boundary spanners**
		√			√				√			√			√		

"Top management involvement is the key element of successful management of knowledge mobilisation. In my organisation, managers and supervisors are willing to let the employees make their own decisions."		√			√			√			√					
"My organisation has knowledge worker team to share and transfer knowledge,."	**Internal**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	facilitators	√	√		√	√		√	√	√		√	√	√	√	
			√					√					√			

Furthermore, boundary spanner contextualises the expertise by communicating with farmers or producer associations. To connect rural farmers with the researchers all over the world, the farmers' union, research institutes or training centres could also generate a self-driven farming system to manage all the crucial things. In agricultural food industry, authorities are expected to possess the whole idea about the agri-food supply system and vital information regardig its operations. They have to keep communicating with the farmers and give necessary advice. Acknowledging farmers is the key to streamline the supply chain process where the authorities can create demand driven mindset by providing a sufficient knowledge on consumer requirements, farmer techniques and so forth. In Brittany, France there are research and experimentation centres (i.e., CERAFEL-association of producer organization; VEGENOV-biotechnology; OBS-seed selection and product variety; CATE-greenhouse and open field) and training centre (i.e., ISFFEL), which are act as the role of boundary spanners (see table 4.7).

Table 4.7: Knowledge broker matrix

Knowledge broker	Main activities
CERAFEL	Supportive agricultural policy for food, spices and allied agricultural crops; stable prices for agricultural products; increase production in selected crops; customer friendly and result oriented administrative system; investigation on marketing issues.
VEGENOV	Cell biology; genetic fingerprints of plants and their pathogens; crop protection (stimulation of plant defenses, disinfection of greenhouses and shelters, products pesticides ...); sensory and nutritional quality of fruits and vegetables; monitoring, consulting and support of innovation.
OBS	Planting breeding; increase yield per plot; introduce resistance and improve plant efficiency; satisfy specific consumer expectations
CATE	Guaranty competitiveness of the products (production costs, commercial quality); development of sustainable agriculture and food security; work on diversification and segmentation.
ISFFEL	Collection, analysis and dissemination of market information; analysis on consumer behavior; conducting surveys to establish benchmark conditions; researching on problems related to the input supply and support services.

Boundary objects

A massive range of boundary objects is mentioned in the literature. However, it seems that there to be few of solid evidence about the commonly used boundary objects in agriculture

organisations. Thus, in this section, to develop and document the diverse objects employed by agricultural organisations for knowledge mobilisation. In the context of present study, the boundary objects to knowledge mobilisation is considered as initiatives that are well defined, noted, structured and systematically designed, and usually presented in written forms (see table 4.8).

The empirical findings show that the information technology infrastructure (i.e., intranet, video conferencing, database, search engine etc.) is an important medium of communication and widely used in organisations to mobilise knowledge, especially the intranet. It suggests that agriculture organisations should effectively and extensively utilise the intranet for the mobilisation of knowledge to achieve a better performance. The main advantage of the intranet is that the different geographical distance between the headquarters and farmlands make the intranet to share and transfer knowledge significant. In this study, intranet was found to share issues such as:

1. Administrative: calendars, emergency procedures, meeting room bookings, procedure manuals and the latest news about staff membership.
2. Financial: annual reports.
3. IT: virus alerts, tips on dealing with issues with hardware, software and networks, policies on corporate use of email and internet access, and a lists of online training courses and support.
4. Marketing: the corporate brochures, latest marketing news, press releases and presentations.
5. Human resources: employee policies, expenses forms, annual leave requests, appraisal procedures and schedules, new vacancies and benefit plan.

Table 4.8: Empirical evidence for supporting boundary object

First-order codes	Second-order themes	Support from interview cases															Aggregate dimensions
		France				Spain			Italy			Chile		Argentina			
		A	B	C	D	A	B	C	A	B	C	A	B	A	B	C	
"Provide information to the farmers, raise awareness of difference services available through website."	**Website**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
				√		√		√			√			√		√	
								√								√	
"Mobile application with specific agricultural information is applied in my organisation."	**Information technology infrastructure**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
		√		√		√			√		√			√		√	
		√							√		√						
"To code the primary knowledge from the specialist and distribute to the stakeholders."	**Education package**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
			√			√		√	√			√		√		√	
			√			√		√	√							√	
						√											
"Documents related to food safety and public regulation and policy are available for free download."	**Documentation**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	**Boundary objects**
		√			√				√			√			√		
		√			√				√			√					

"Storing knowledge resources such as patents and copyright in database is one of the widely used approach to achieve the management of knowledge."	**database**		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
"Staff are highly dependent on guideline, sketches and diagrams to make the work smooth and more effective."	**Guidelines, sketches and diagrams**		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
			√			√		√		√	√		√			√			
			√			√													
"To promote the product or the services, staff always use the newsletter."	**Newsletter**		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
			√	√	√	√		√	√	√		√	√			√	√		
			√			√				√			√						√

From the empirical findings, the agri-food supply chain partners encounter linguistic barriers. Some partners speak French, some speak Spanish and Italian. Consequently, the supply chain partners encountered many language hinders, communication impediment and mutual misunderstanding difficulties. Therefore, they took several procedures to overcome language barriers; for example, the manager (Italian marketing manager) committed English language courses to better manage the relationship with the partners. Also, he translated the standardisation and reports to allow partner organisation to achieve organisational proximity. This study also found other visual artefacts combined with the language course can support the partners' verbal communication. These artefacts contain PowerPoint slides with visual representations allows sharing with other partners to promote the mobilisation of knowledge. In addition, supply chain partners are trying to construct a mutual space for knowledge mobilisation to neglect all shared information in real time. Thus, the Google portal are used, the partners can integrate and document everything happens on the project website. Further, in fact, the partners recognised that they need to abstract an electronic data interchange (EDI) to link the organisations to ensure the coherence of shared information and facilitate communication.

From the farming side of the chain, the empirical findings show that substantial yield differences sometimes due to wrong choice of variety, harvest loss due to wrong setup and lack of standardisation of changeovers. Thus, the standardise is important because it could disseminate the best practices. Also, the database is important because of a lack of communication along the chain. Improving knowledge flows between hauliers, farmers and central store improves delivery performance. As shown in the empirical findings, most farmers orders for new seed were received at the last minutes and this force the farmers to keep seed inventory and sometimes they choose to return the sufficient seed stock back to the supplier. Last minute orders also indicated certain farmers can't get the ordered varieties due to

unavailability. Database could solve this issue to a great extent. Therefore, database is considered as the widely used objects in the agricultural industry.

Boundary interactions

In the present study, boundary interactions to knowledge mobilisation are described in table 4.9. Regular boundary interactions in agri-food industry took place at the formal meetings. This means the conventional approach to knowledge mobilisation are still highly used in agri-food supply chains. The interviewees think that face to face interactions is the easiest ways to share knowledge. In the context of agri-food industry, face to face meeting aims to share technical knowledge between site agriculture experts and farmers. The technical knowledge was shared mostly by word of mouth from one project to the next. Moreover, the positive results of face-to-face meetings could be taken into consideration to be the best way for the organisations' future development.

Running training programmes to build understanding of knowledge mobilisation is also important in agriculture organisations. Training is the common approach to knowledge sharing. However, empirical findings also indicate that formal training programmes will cause high cost, on the other hand, there is a lack of time for employees to join the training programmes. Therefore, it is said that some organisations would not be willingness to invest in running adequate training to build up awareness of the knowledge mobilisation. Moreover, in SMEs, they don't possess enough effective resources which will hinder to adopt training. Managers in SMEs are more sceptical about the benefits of training. Other reasons include that training activities would not produce benefits, such as more cost, less working time and the inability to cover work while employees are participating in the training programme.

Fieldwork in agriculture industry is very popular based on the empirical findings. In Brittany, France, every summer, stakeholders would visit the region. The first visiting place is the Auction market, a local speciality. The sales method is very special in the Auction market, all

batches locate buyers at the most possible proper price. That usually is a huge difference between price paid to the farmers and what customers pay in the Auction market. Sometimes, a double or even triple price since this is to be expected as transporting and distribution costs has to be covered. After the visit to the Auction market, stakeholders head to a farm and meet the farmer who explains his profession to them.

In addition, over the past few years, the workshop in terms of how to make a cauliflower soup stand on nutrition was organised. These workshops possess two major advantages. Firstly, the workshops enabled the farmers to meet and make conversation in an atmosphere very friendly. Enjoying a tasty dish promotes enjoyable discussion and offers them an opportunity to describe the way how they grow the product. It is also a chance for farmers to contact with one another and make connection.

Table 4.9: Empirical evidence for supporting boundary interaction

First-order codes	Second-order themes	Support from interview cases															Aggregate dimensions
		France				Spain			Italy			Chile		Argentina			
		A	B	C	D	A	B	C	A	B	C	A	B	A	B	C	
"In my organisation, face to face meeting is most often used to share knowledge, maintain relationships and look for possible solution."	**Face to face meeting**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
				√		√		√			√			√		√	
								√								√	
"Video conferencing allows employees in different locations to hold meetings without having to move from one place to another. "	**Video conferences**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
		√		√		√			√		√			√		√	
		√							√		√						
"We have a fieldwork every summer to interview with AFSC practitioners which is very interesting."	**Fieldwork**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
			√			√		√	√			√		√		√	
			√			√		√	√							√	
						√											
"In forums, open discussion can enhance the understanding of each stakeholder's requirement and very helpful to transfer and share knowledge."	**Online/In site forums**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	**Boundary**
		√			√				√			√			√		
		√			√				√			√					

"It is a small group interviews involving similar people who have the common experiences in order to generate data. This interaction examines not only what people think but how they think and why they think that way."	**Focus groups**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		**interactions**
		√		√			√	√		√		√		√		√		
		√					√	√						√		√		
"Bring people together and offering them a learning session to know how people can work together as a whole and as a team."	**Learning sessions**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		
		√			√				√		√	√		√		√		
		√							√			√						
"HR department is responsible for the training programme, which offers the necessary tools for staff to do their jobs properly. It also helps people develop their skills and become valued members of the workforce."	**Training programme**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		
		√	√		√	√		√	√			√	√		√	√		
		√			√								√					
"In my organisation, there is a cooperative relationship with the suppliers. The aim is to provide direct benefits to all participants."	**Stakeholder engagement events**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		
		√			√		√		√			√		√	√	√		
		√										√						

4.5 Comparative analysis and findings

The comparative analysis was used in this study. Unlike the thematic analysis, which has been used to allow new themes to emerge by coding and to confirm existing themes from the transcript; the comparative analysis has been used to examine the set of themes across 15 organisations to detect the strength of evidence from empirical data, especially to confirm the empirical findings where there was less support from the literature (see section 4.4.2). Furthermore, using the comparative analysis, data from 15 organisations is compared and contrasted, this has helped to understand the differences of knowledge mobilisation amongst them.

In the semi-structured interviews analysis, organisations are classified into two groups that are Europe and South America. In this study, above two groups are discussed. It is well known that effective knowledge mobilisation activities are critical for an organisation in global economy. In addition, based on the findings of this study, culture does play a vital role in promoting the implementation of knowledge mobilisation for organisational success. However, the recognition given to the importance of culture, and its influence on knowledge mobilisation have been seldom mentioned, particularly in developing countries. Most studies on culture and knowledge mobilisation have focused on developed countries such as the European countries. Thus, this study engages in a comparative examination of above two major regions and contributes to understanding of the dimensions of culture and differences of knowledge mobilisation between Europe and South America agri-food industry.

4.5.1 KMob in Europe

A successful implementation of KMob must adopt a range of knowledge mobilisation technologies. In Europe, advanced technology facilitates and enable KMob implementation. Thus, a technological issue is not the main concern in Europe, but a cultural question. In recent years, the European Union (EU) has included more and more new member states, this

enlargement process has increased the cultural diversity. Different languages have been emerged into the EU as well. People are free to move within the EU, it is very important to increase people's understanding of other cultures and their languages. Also, individual factors such as value, worldview, mental model, interpersonal trust and personality are considered as cultural barriers for effective knowledge mobilisation. Though several relatively sophisticated systems may contribute to knowledge mobilisation in the Europe business settings, there is no guarantee that employees will share their knowledge. Thus, developing an organisational culture is beneficial to operation (McDermott and O'dell, 2001). The boundary objects also play very important that need to be opened and remodelled. In this context, it can be understood as the institutionalised systems of organising, storing and disseminating knowledge cross national and cultural boundaries. Here online publications, peer-sharing and social media have a significant potential in this respect. At the same time, schools, libraries and local government could take the initiative to develop more coordinated boundary objects for various online services in Europe. Moreover, how to transform the boundary objects, this kind of person called boundary spanners. They are responsible for promoting the conversion of knowledge into wisdom. Thus, the education institutes, universities and advisory agencies play an important part to overcome the cultural diversity.

In the interviews, several more issues have been highlighted as factors to affect the knowledge mobilisation. For example, lack of communication skills. Ineffectively communication could create hardship, especially transfer the tacit knowledge. In addition, unsound personality and work value also cause the individuals unwilling to share knowledge. These issues would lead to the lack of trust within the agri-food supply chains in Europe. However, they will be nurtured or changed through reward systems.

Finally, communities of practice (COPs) are becoming the core boundary interactions for support knowledge mobilisation. Europe have invested a large amount of money and time in

foresting and organising COPs when they implement knowledge mobilisation activities.

4.5.2 KMob in South America

Several years after being introduced from the west, KMob in South America is still at early stage. KMob in agri-food organisations in South America only focuses on the surface of knowledge creation and using. Also, there are much more conceptions and much less practice when application of KMob. The empirical findings show that KMob practices remain sparse in South America organisations despite the genuine interest proclaimed by many managers over this matter. Budget reasons are put forward by managers to explain why KMob programmes don not take off in this region. Perhaps a fundamental reason is that knowledge and innovation are not important factors of production in South America contrary to what happens in Europe. In addition to this, some KM practices will be less effective if they are not supported by the appropriate management of the human resource because the most organisations have little concern in seeking the relation between KMob and organisational strategy. Moreover, the cultural characteristics such as paternalism, lack of trust and social inequality can be considered as serious barriers to knowledge mobilisation initiatives in this region. First, in South America, individuals seek partners with similar characteristics to mobilise knowledge. At the organisational level, knowledge mobilises best when knowledge contributors and recipients are considered members of the same community and share the same value, codes and narrative. Then, authority and hierarchy exist in the South America for over hundreds of years. Both social and organisational hierarchy have a negative impact on knowledge mobilisation performance. Traditional cultural elements are gradually losing their power in shaping individuals' decision making. At last, the relationship networks also influence the knowledge mobilisation in South America. The interviews findings presented that individual rely on close personal relationships are more likely to share and transfer knowledge (Fan, 2002; Borgatti and Li, 2009). Many South America enterprises simply copy and adapt Western theories and

practices without taking into account the influence of culture factors. Therefore, South America agricultural enterprises should consider the impact of cultural aspects while developing and implementing knowledge mobilisation processes and strategies.

From the empirical findings, the evidence shows that KMob has been disregarded in universities. The same study finds that advisory services in KMob are also almost non-existent among the best-known advisory services in human resources. Therefore, open days and governments' support are used for educating stakeholders to tackle or alleviate the knowledge boundaries. Combined with the reality of that farmers are elderly and low-educated, it is relatively difficult for them to change their knowledge base. So knowledge sender need to develop stakeholders' interest in it through boundary interactions.

In relation with the use of the technology, according to the industry type, a majority of organisations have an intranet and familiar with e-learning practices and also use sophisticate databases and information management systems. The results the researcher found that in terms of the use of technology are higher than the expectation. Considering overall results, knowledge mindset has increased and spread throughout South America.

Based on the semi-structured interviews, of these two regions, one is the developing countries, the other is very innovative and developed countries. Europe and South America share several similarities in KMob, but also have marked differences are summarised in Table 4.10.

Table 4.10: Similarities and differences between Europe and South America KMob

KMob	Similarities	Differences
Definition	The awareness of definition of KMob is on clear level for both of regions	There are much more conceptions and much less practice in South America
Boundary objects	Both of them believe boundary objects is very important	Individuals in Europe have more experience on boundary objects than South America
Process	Both of them consider KMob as a continuous and dynamic interaction process	In South America, the process can be considered as contextualization,
Goal	Make profits, spread best practice and problem solving	In South America, people seek the harmony; In Europe, people aim to improve productivity
Approach	Both of them use formal and informal approaches to mobilise knowledge	South America uses informal communication very often to mobilise knowledge
Factor	Unwillingness to share knowledge due to lack of trust, time constrains and communication skills	In South America, paternalism, lack of trust and social inequality are considered as serious barriers; In Europe, cultural diversity is the most critical issue in KMob

In table 4.10, some aspects are compared between Europe and South America which can provide a basis for cross-border analysis or for linking data with other national or international studies. This makes it easier for researchers to understand KMob in different regions and may have the possibilities to improve KMob in agri-food supply chains in better level.

Nowadays, the business environment exerts more pressure on AFSC managers to force them to respond and act quickly, which intensifies the need to develop strategies to overcome knowledge boundaries. Therefore, having a deep understanding of boundary-spanning mechanisms plays a key role in AFSC companies' growth. This chapter results indicate that boundary spanners, boundary objects and boundary interactions are effective in tackling

knowledge boundaries with appropriate inputs. In order to help AFSC practitioners to target and deploy resources accordingly, a knowledge mobilisation department should be formulated in the agricultural industry. Research institutions/governments are responsible for effectively transferring and sharing knowledge. Other agricultural practitioners such as farmers are advised to build relationships with experienced research institutions/universities/professional organisations to acquire knowledge, as these institutions have expertise in communicating with farmers. In addition, key elements for tackling knowledge boundaries have been identified, which provides a guideline for the local company in the AFSC to improve their boundary-crossing capability. Thus, effective boundary interactions for all AFSC practitioners to increase their common understanding of domain-specific knowledge is essential, particularly for the context where there is much distrust between different AFSC practitioners.

4.6 Summary

This chapter discussed the development of the empirical KMob framework. The framework should encourage stakeholders to understand how and why it is necessary to improve knowledge mobilisation. The framework provides a graphical representation of the key factors that affect the successful implementation of knowledge mobilisation in the context of agri-food supply chains. The findings were obtained by employing thematic analysis and comparative analysis. This was done to highlight the similarities and differences in the emerging themes. Based on the empirical findings, the conceptual KMob framework developed in Chapter 2 has evolved to the empirical KMob framework, as shown see Figure 4.3.

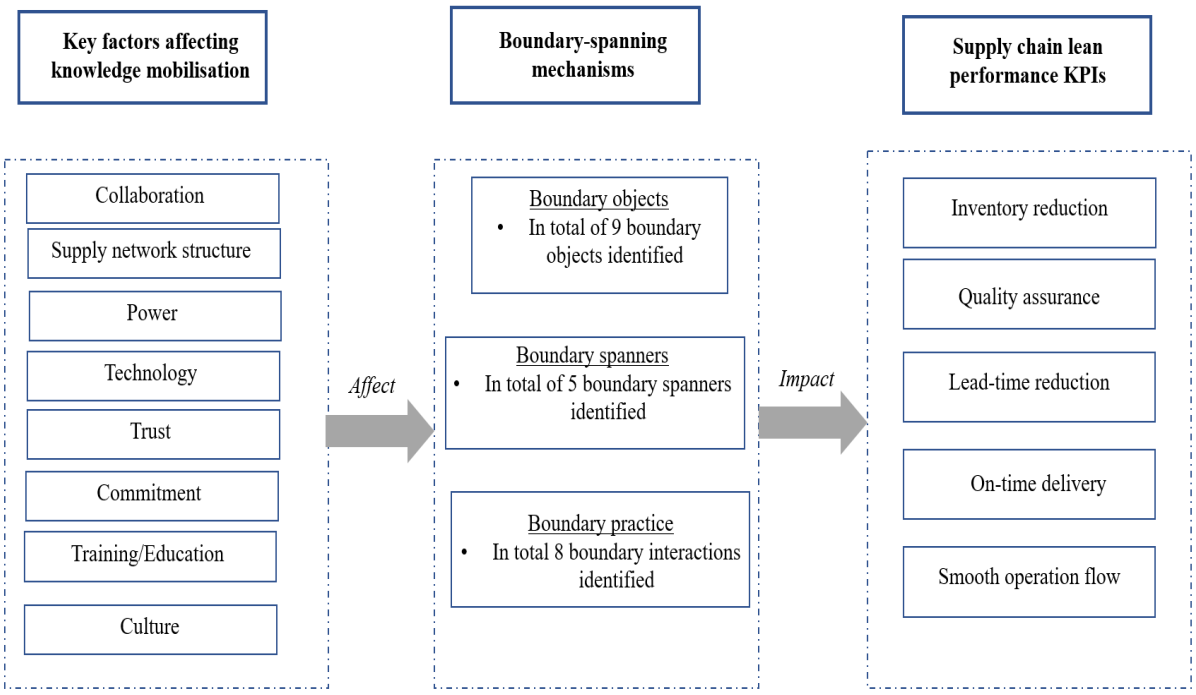


Figure 4.3: The empirical KMob framework

As can be seen from Figure 4.3, eight key factors supported by the interview data. These key factors are: 1) collaboration, 2) supply network structure, 3) power, 4) technology, 5) trust, 6) training/education, 7) culture and 8) commitment.

In total of five boundary spanners emerged from the analysis of empirical data at this stage: 1) knowledge brokers 2) knowledge workers 3) different level of management 4) internal facilitators 5) external facilitators. The nine boundary objects discovered from empirical data are: 1) Websites 2) PowerPoint presentation 3) information technology 4) database 5) guidelines 6) newsletter 7) education packages 8) stetches and diagrams 9) documentations. Finally, the empirical data support eight boundary interactions: 1) face to face meetings 2) video conferences 3) fieldwork 4) online/ in site forum 5) focus groups 6) learning sessions 7) training programmes 8) stakeholder engagement events have been refined. Next chapter will explore the impact from the three categories of boundary spanning mechanisms on supply chain lean performance KPIs, that is, the second and third building block in the empirical KMob framework.

Chapter 5 Empirical stage two: quantitative data collection, analysis and findings

5.1 Introduction

The chapter aims to analyse impact of knowledge mobilisation on lean performance with SEM analytical tool. For purpose of addressing the third research questions, three hypotheses have been drawn based on three categories of boundary spanning mechanisms (i.e., boundary spanners, boundary objects and boundary interactions) and five lean key performance indicators in agri-food supply chains. In the following sections, the results of three hypotheses (H1, H2 and H3) by SEM are concluded. The results were analysed via AMOS v26 software program with maximum estimation method. Based on previous literatures, hypotheses are as follows:

H1: "Boundary spanners" has a positive impact on lean performance.

H2: "Boundary objects" has a positive impact on lean performance.

H3: "Boundary interactions" has a positive impact on lean performance.

Figure 5.1 the illustration of research model of quantitative phase. The research model is used to analyse the relationships between boundary spanning mechanisms and lean supply chain performance.

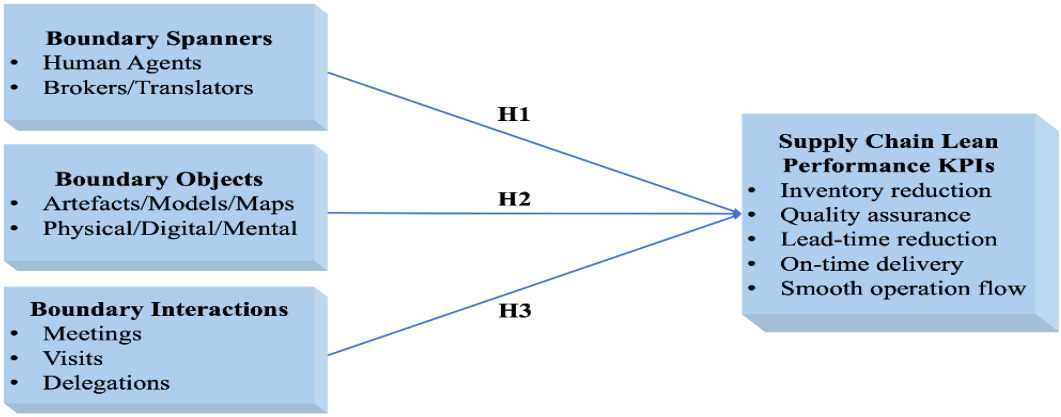


Figure 5.1: The research model for quantitative phase

The chapter also illustrates how to adopt SEM method in the study, how to design the questionnaire, and how to collect data to investigate the impact of knowledge mobilisation on lean performance, to expand the discoveries in the qualitative stage, and to answer the third research question.

5.2 Data collection with questionnaire survey

5.2.1Questionnaire design

Based on literature review (see chapter 2), despite supply chain members devote themselves to developing a common knowledge that can used to share and assess the domain specific knowledge of each other's practices (Carlile, 2004), they still have trouble in experiencing difficulties in sharing knowledge due to differences in their language (Bechky, 2003). **Boundary spanners** are middlemen, intermediaries, or agents who act as interface among individuals, groups, and organisations from different domains (Keszey, 2018). It enables knowledge exchange and bridge cognitive gap among different domains, therefore, facilitate evidence-based decision-making (Glegg and Hoens, 2016). It can be classified into three categories based on the membership status of the spanners (Neal et al. 2022): (1) boundary translators – individuals who have membership in only one party; (2) boundary brokers – individuals who have membership in both parties that are involved in KMob process; and (3) marginal people – individuals who have membership in multiple parties. **Boundary objects** are a common knowledge to a number of involved chain actors that can be used to improve participant's understanding, it may overcome syntactic, semantic and pragmatic boundaries, and hence contribute to knowledge mobilisation across supply chains (Carlile, 2004). **Boundary interactions** is an effective boundary spanning mechanism used for overcoming knowledge boundary by engaging agents from different knowledge domains in collective activities (Hawkins and Rezazade M, 2012).

Keeping excess products in stock does not add value. It leads to an increase in lead-time,

prevents the rapid identification of problems and increase space. Various ways of **inventory reduction** are to reduce set-up time and change layout to reduce transportation distance for products. In a lean supply chain, **quality assurance** is the responsibility of every chain actor. Total quality management can be used to improve overall operation performance. Any movement in the chain can be viewed as waste. **Lead-time reduction** aims at identifying more efficient ways to complete the operation. Most of the food manufacturers have to do business with powerful retailers who demand on-time delivery, a complete cycle of planning and execution helps improving **on-time delivery** performance. The food industry must be able to quickly respond to customer demand, manage **operation flow smooth** is the responsibility for chain actors.

Quantitative data investigation originated from questionnaire design. A well designed survey questions about a particular study intend to achieve research aim and objectives and provide information that is useful for data analysis. In this study, the questionnaire design was based on the existing literature in the surrounding domain of knowledge mobilisation and lean performance KPIs, as well as the findings from the qualitative phase. The questionnaire has been divided into three parts based on the research question. The first part has four general questions in order to identify the background of the respondents. The second part has twenty-four questions according to elements from boundary spanning mechanisms. Through literature reviews as well as the findings from the qualitative phase, this study identified five boundary spanners, nine boundary objects and eight boundary interactions. The third part has eighteen questions in terms of lean performance KPIs. Classified data contributes to correlate as well as explain the results of information from Likert scale questions.

Part 1 General questions

1. *Please state the highest degree you possess*

The question provides an opportunity to determine the degree of respondents. On the basis of this, hypothesis could be made to determine respondents at which level of education are directly

participation in the application of knowledge mobilisation as well as lean in the agri-food supply chains.

2. *Please state your education discipline*

The purpose of this question is to investigate the subject areas of the respondents to determine the background knowledge the respondents have.

3. *Please declare the role in your organisation*

The question asks for present role of the respondents. The reason why chooses the role rather than job title is that in agri-food supply chains, for example, the respondent as a supply chain manager is related to lean management and other roles as well.

4. *Please state the working years with your present employer*

This question investigates years of experience of respondents. Based on this, it makes clear that the standard of consciousness in groups with distinct working years on sharing and transfer knowledge.

The following section of the questionnaire focus on addressing the third research question of this study. The purpose of these problems is to get ordinal proportions of the data.

Part 2 Knowledge mobilisation process

This part of the questionnaire focuses on examining the level of knowledge mobilisation process in the application of lean performance in agri-food supply chains. In this context, process refers to a variety of tasks as well as activities. As with the literature review results, this study needs to be validated by respondents who directly involved at the strategic level of the agri-food industry. The part is consisted of 3 sub-questions. The purpose of sub-questions is to assess the activities the level in knowledge mobilisation (boundary spanners, boundary objects and boundary interactions) in the application of lean in agri-food supply chains. In order to obtain the ordinal data of respondents, Likert five-point scale was used for selection from very low to very high.

Part 3 lean performance KPIs

This part identifies the lean KPIs related to effectiveness of sharing as well as transferring knowledge of agri-food supply chains. This part is divided into five sub-questions (inventory reduction, quality assurance, cycle time or lead-time reduction, on-time delivery and smooth operation flow). The purpose of sub-questions is to assess the standard of KPIs in lean supply chain management within agri-food industry.

Moreover, the pilot study was used in this study, and the initial draft of the questionnaire was refined through systematic use of pilots. Thus, the researcher examined the questions that were used by other surveys on a similar topic and received help from the experts in the fields before finalising an initial draft of the questionnaire.

It is a common phenomenon that pilot testing is used in social science research. For example, pilot testing is often used before final data collection. In other words, the use of pilot testing is valuable in a small scale feasibility study normally carried out in preparation for the major study. Most importantly, the purpose of pilot study is to validate the instrument, ensure its clarity and eliminate ambiguity in order to maximise response rates (Saunders et al., 2019). In this study, the quantitative data derived from 30 completed questionnaires to help researcher increase instrument clarity and remove ambiguity. The questionnaire was structured to allow respondents to check from a list of options, rank a number of options, and also to add further options with explanation. Most questions were to be answered using five-degree Likert type scale. There was also an open-ended question to provide participants with an opportunity for commenting on the questionnaire.

5.2.2 Sampling strategy

The quantitative phase data collection used purposive sampling and snowball sampling. First, data collection started from RUC-APS partners. Then, a questionnaire was sent out to contact recommend by RUC-APS partners to scale up the sample size via snowballing effects. In addition, the questionnaire was also sent to professional groups and databases such as FAME.

This justifies the applicability and suitability of purposive and snowball sampling techniques for this quantitative phase.

To maximize sample size and minimise lack of responses, quantitative data was collected by two ways: paper-based survey and e-survey. Paper was distributed among sixteen organisations which are partners of RUC-APS. The e-survey was designed at Qualtrics, and the e-questionnaire was allocated via three channels.

- Websites: Call participants (https://www.callforparticipants.com): made a research on this website profile, participants were asked to fill out the electronic questionnaire. The purpose of site is to accelerate study by college or/and university students, just so they could recruit participants from their own networks.
- Professional groups: A list of sixteen organisations, as partners on the consortium of an EU Horizon 2020 project, RUC-APS (Risk and Uncertain Conditions for Agriculture Production Systems), were approached because the researcher belongs to a partner on the RUC-APS project and has access to other partner organisations. Also, professional groups like lean agri-food supply chain and knowledge management were reached by LinkedIn professional network. A dialogue opens with a link to an online questionnaire as well.
- Email questionnaire: From FAME database, there were around 180 organisations. The organisations received approximately 300 e-mails containing information and the purpose of the study as well as the link to electronic questionnaires.

Nowadays, with the advent of information technology, the use of electronic questionnaire design for online surveys has been increased. Compared with other survey methods such as on-site survey and mail survey, online survey has many advantages and disadvantages (Nulty, 2008). Fink (2015) quoted online survey, which is designed as well as accomplished online and cover a large geographic area containing insignificant distribution costs. The way of survey

method is also useful for validation purposes since it permits just necessary answers. Moreover, scholars could easily follow up response rate of the respondents as well as send automatic reminders to respondents.

In addition, electron investigations offer other specific advantages to those who need to carry out them, such as, ease of usage, confidentiality, as well as the ability to reduce onerous data entry and analysis work are some noteworthy advantages of this approach. Apart from the noteworthy advantages, scholars should take into account the disadvantages and shortcomings of electronic questionnaires. For instance, participants must be self-motivated to return the completed survey (Nulty, 2008). Therefore, the inadequacy of the response rates is also a particular problem in this method. Most importantly, the selected respondents must be connected with internet and able to use a browser (Fink, 2012).

However, the paper investigation is a traditional survey way as well as always suitable for respondents who are not good at computers or have no internet access. Besides, using pen and paper surveys can yield useful information with a high response rate. Compared with online investigations, the paper investigation can answer questions more conveniently, even on sensitive themes (Fink, 2012). By contrast, scholars must keep in mind the potential shortcomings that are often presented in paper and pencil or self-administrated investigations. Such as, this type of investigation usually needs self-motivated respondents to get back the questionnaire and existence of researchers in the period of administration. In some cases, respondents could return an incomplete questionnaire which resulting in a low response rate that reduces the worth of consequences.

5.3 Data analysis with structural equation modelling (SEM) method

SEM is a statistical model technique has been widely applied in social sciences. It could bond factor analysis with regression or path analysis. Theories in the social sciences often relate with complicated manners of relationships or distinctions between many variables, conditions, or

groups. Generally speaking, SEM permits model and testing of complicated relationships, containing a large number of hypotheses simultaneously as a whole (containing average structure as well as group comparisons). If other analytical methods are used, this usually requires several divided analysis (Werner & Schermelleh-Engel, 2009).

Although SEM contains a variety of powerful analysis techniques, some of these techniques can be easily misuse. Most of the criticism against the use of SEM revolves around two issues. One issue is the importance of statistical assumptions as well as sample sizes required. Many researches have been done on the importance of the normality hypothesis as well as sample size required to be confident of consequences. Another issue that may be related to the casual usage of SEM is the causal interpretation. The application of SEM is mainly focused on non-experimental data. Many applications of SEM still interpret the final model to be a causal model. This may be true, but SEM does not magically translate relevant data into causal conclusions. Therefore, the users of SEM should be reminded the fact that SEM model has been affirmed by data, but it does not mean that it has been proven to be correct. In general, an explicit comparison of competing models is more convincing than testing only one model (Jeon, 2015).

5.3.1 Fundamentals of SEM

The origin of the SEM is path analysis, invented by geneticist Sewall Wright. Drawing a path diagram is still a common way to start the SEM analysis. A path diagram is consisted of boxes and circles, linked with arrows. In the notation of Wright, rectangles or square boxes stands for observed (or tested) variables, and circles or ellipses stands for latent (or untested) elements. The single headed arrow is defined causal relations in models, and the variable at the end of the arrow causes the variable to be at the point. Double headed arrows represent covariances or correlations, with no causal explanation. In statistic, the regression coefficient is represented by single headed arrows, and covariance is represented by double headed arrows.

SEM method has several basic terms and steps. SEM consists of measurement equation

(confirmatory factor analysis) and structural equation (path analysis). In addition, the correlation between exogenous variable is thought about in a model and expressed as a curve. Besides, the structural error of endogenous variable is taken into account. Thus, confirmatory factor analysis, correlation analysis, as well as regression analysis can be performed simultaneously in one model. In the study, confirmatory factor analysis (CFA) was used to measure the validity of selected variables by assuming the adequacy of factor structures. Path analysis was used in the structural portion of SEM to measure the hypothesis causal relations between KMob (exogenous variables) and lean performance (endogenous variables).

Validation of scale is a vital aspect of any studies. In empirical, if the reliability and validity of the scale are uncertain, it is difficult to ensure the reliability of the study. In CFA, scholars need to design a hypothesis because it permits the scholars to identify a model on a logical basis. Therefore, scholars first design some hypothesis models and then measure to confirm the inferences of the relationships between observed as well as potential variables (Sureshchandar, Rajendran, & Anantharaman, 2002). Therefore, the inseparable part of CFA is a rational prior knowledge of elements that illustrate the interrelation of tested variables. In this sense, CFA is better suited than any other approach in this respect because it is based on logic. This is especially true when the researcher has fairly good prior knowledge of the observed variables and other theoretical findings. In fact, KMob and lean performance models are not only established in theory, but also empirically tested in previous chapters. CFA is therefore the choice for scaling and validation purposes.

Path analysis is a method of researching direct and indirect ways. It provides a basis for the establishment of causal model established by scholars. Path analysis can be thought of as SEM, which consists of all observed variables rather than using potential variables. Path analysis permits the analysis of relations between dependent variables as well as between independent and dependent variables from single analysis. In path analysis, path coefficient is counted. It

shows the direct impact of a variable is assumed to be the cause of a variable and is considered to be the effect of a variable. In multiple regression analysis, the dependent variable is a regression analysis of all independent variables. But in path analysis, multiple regression analyses may be required (Jeon, 2015).

5.3.2 SEM using AMOS software tool

Software cannot become a statistician, but the emergence of SEM software has a huge impact on this field. AMOS, LISREL and Mplus are probably the most famous programs. While every program has its own advantages and disadvantages, any package can be used for standard analysis.

AMOS, software program, permits researchers to study information conveniently. Such as, multiple models, one of which is sample data that can be applied to different populations at the same time. The method relates the test on invariance of critical parameters across groups. In addition, with AMOS, there is no need syntax or complex program language to perform the software. This is an advantage for beginners or those unfamiliar with program languages. The latent and explicit variables are briefly described by AMOS and connected by arrows.

5.3.3 Process of the SEM

In this study, a causal model applied to measure the assumed relations between KMob (exogenous variables) and lean performance (endogenous variables) by a system of linear equation. In methodological, a representative SEM analysis proceeds via varieties of consecutive procedures. Details of the SEM process are presented as follows:

1) Model specification

The first step in the design process of SEM is a valid hypothesis model based on related theories and literature (Suhr, 2006). Therefore, both KMob and lean performance establishment applied in the study offered an academic background for item specification in the situation of agri-food supply chains.

In order to build an exactly appointed model, the dependent variable (the endogenous variable) must revert to the independent variable (the exogenous variable). In other words, dependent variable is predicted by independent variable. The showed structural model appointed for assuming test in Figure 5.2 includes one exogenous (i.e. independent) as well as five endogenous (i.e. dependent) variables. The path graph indicated in Figure 5.2 shows structure relation between every element of KMob (i.e. SPA) as well as lean performance KPIs (i.e. INV, QUA, TIM, SMO and DEL), intentionally anchored in model to test the relationship between KMob as well as lean performance.

2) Determination of model recognition

In SEM, the identification problem is a mathematical requirement that needs to estimate whether parameters are consistent with data points. The adequacy of model as well as acceptability of sample size were also certified by the degree of over-determination of elements. The results show that only the over-recognition model with fewer parameters than data points can be tested. Nevertheless, because the parameters are more unpredictable and different parameter values define the same model, so the unrecognised model cannot be evaluated. In the situation of assuming test by SEM, the over-identification of every model has been measured. The magnitude of the load (or regression weight) shows a significant portion of the variance in the corresponding element. The model fitting results also show that the hypothesis model has statistical significance and slightly acceptable fit.

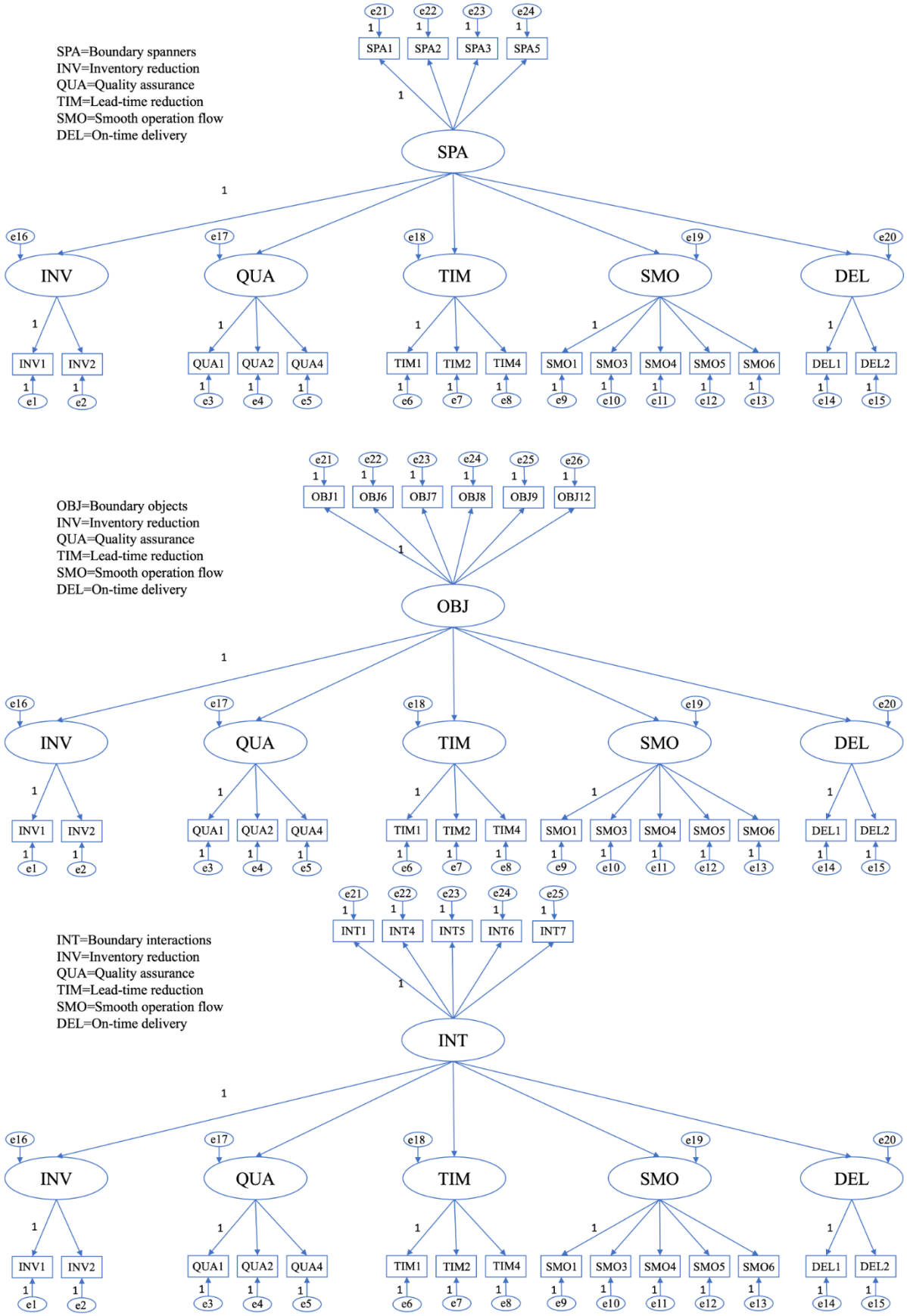


Figure 5.2: Structural model illustration

3) Model fit assessment

In SEM, it is possible to decide whether to accept the model according to the model fitting evaluation. The best fitting model decides its degree of fitting with data. There are three model fitting indexes in model fitting evaluation, which are absolute fitting index, substitute fitting index as well as comparative fitting index. Absolute fitting index offers model fitting information when the variance covariance matrix (Σ) is equal to specimen variance covariance matrix (S) (Harrington, 2009). Unlike other indices, Chi-Square (χ2) is the most usual absolute fit index, which decides how the model fits accurately in the population. A large χ2 estimate indicates model does not suit the data good enough and it does not adequately reproduce specimen covariance. Conversely, a small χ2 estimate indicates model suits the data good enough since predicted covariance matrix (Σ) is equal to observed specimen covariance matrix (S) (Albright and Park, 2009; Brown, 2015). In some cases, however, χ2 does not report an accurate estimate of the model fit, or the fit statistics may not illuminate conceptual views that can establish fit assumptions between the model and the population, and then usually consider another fit statistic. Therefore, the root mean square error of approximation (RMSEA) also needs to be considered for accurate measurement. In general, RMSEA is the most important model fitting statistics and can be applied as an option of accurate evaluation of model fitting. When there is no relationship between variables, it is generally considered that the covariance between all input variables is fixed at zero (Harrington, 2009; Brown, 2015). Therefore, the results of the fitting index are compared with the one-dimensional evidence within the limits of the threshold under consideration.

Therefore, multiple-fit indicators need to be evaluated goodness-of-fit and the final results. Absolute fitting indexes such as likelihood ratio statistic Chi-square (χ2), normed Chi-square (CMIN/DF) and approximate RMSEA were used to evaluate the fitting ability of the whole model. Then, the hypothesis model was compared with some baseline models and criteria using

goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), Comparative goodness-of-fit index (CFI) and standardized root mean square residual (SRMR). CMIN/DF was applied to survey estimation models and whether the model could be improved by assigning fewer estimated parameter paths (Hooper, Coughlan, and Mullen, 2008).

4) Presentation and interpretation of consequences

The Last procedure in SEM is the statement and interpretation of results so that claims can be made about the structure. The scholar needs not only makes data steadily available when showing consequences of the paper, but also needs more detailed explanation of the results. In the study, the scholar showed required consequences based on a suggested model from former chapters. The following sections summarise the consequences of hypothesis testing in more detail.

5.4 Quantitative data analysis

The section depicts how to analyse quantitative data with many techniques. As explained, different authors suggest that no less than 200 is appropriate to guarantee robust SEM and provide any degree of confidence for parameter estimation (Byrne, 2013; Hair et al., 2009; Kline, 2015). Therefore, in total 500 surveys were sent, among which 364 were returned and deemed usable. That is to say, the information gathering procedure yielded evaluations of 364 respondents of knowledge activities in their separate organisations. Following sections will explain the response rate, descriptive analysis and confirmatory factor analysis.

5.4.1 Response rate

All 500 questionnaires were allocated in paper and electronic edition. In total, 146 respondent completed the paper survey. The 12 of them were invalid because of incomplete answers. Therefore, responses of paper investigation were 89%. On the other hand, 350 questionnaires were distributed through online survey. There are 230 respondents finished online questionnaire and response rate was 66%. In both version of surveys, a total 375 questionnaires

were returned, thus the total response rated remained 75%. However, a total of 73% (364) valid and finished investigation applied for the quantitative information study. Figure 5.3 indicates a conclusion of electronic and paper investigation response rate.

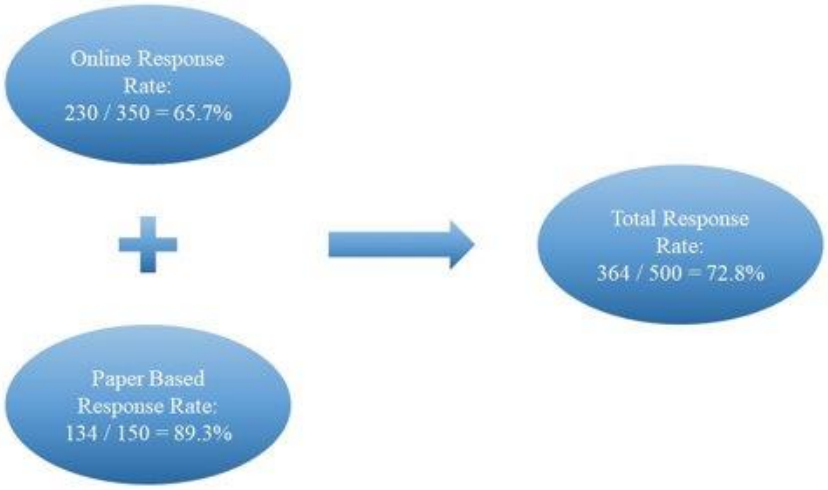


Figure 5.3: Response rate

5.4.2 Descriptive study

All respondents were enquired a series of individual as well as categorical questions to determine suitability for inclusion in the research and outline the profile of the beneficiaries (Howitt & Cramer, 2008). For this study, the survey is demographically distributed according to the employee's highest degree, education discipline, major job function and length of service.

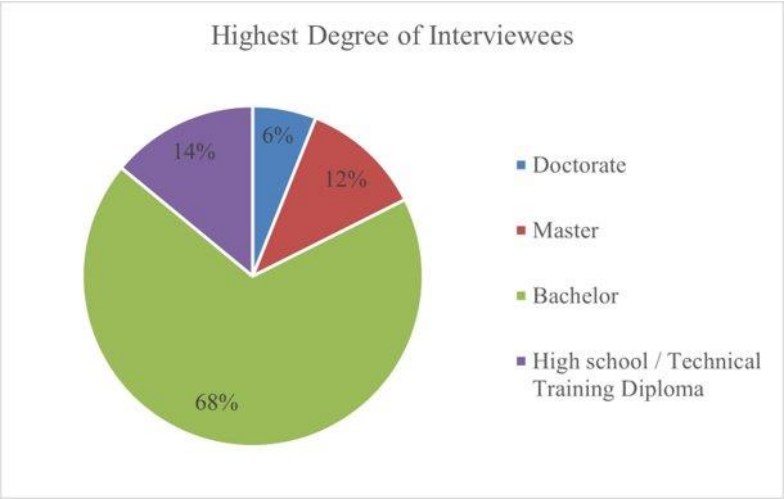


Figure 5.4: Highest degree of interviewees

As shown in Figure 5.4, in terms of the employee's highest degree, 6% of respondents have PhD degree, 12% master's degree, 68% bachelor's degree and 14% high school/technical training diploma.

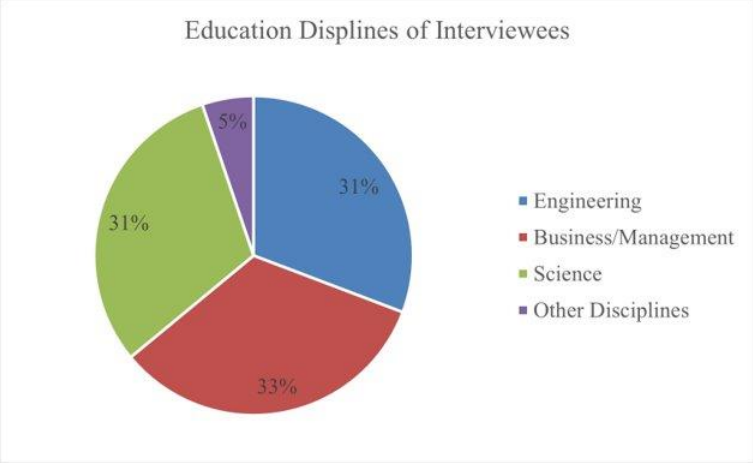


Figure 5.5: Education disciplines of interviewees

Figure 5.5 indicates frequencies of employees' responses based on education discipline, 31% of the respondents are in engineering, 33% are in business/management, 31% are in science and 5% are in other disciplines.

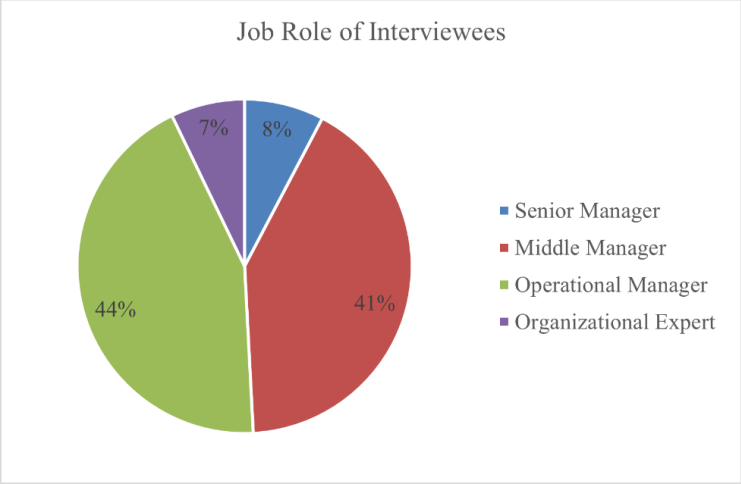


Figure 5.6: Job role of interviewees

As shown in Figure 5.6, in terms of employees' job function, 8% are senior managers, 41% are middle managers, 44% are operational managers, and 7% are organisational experts.

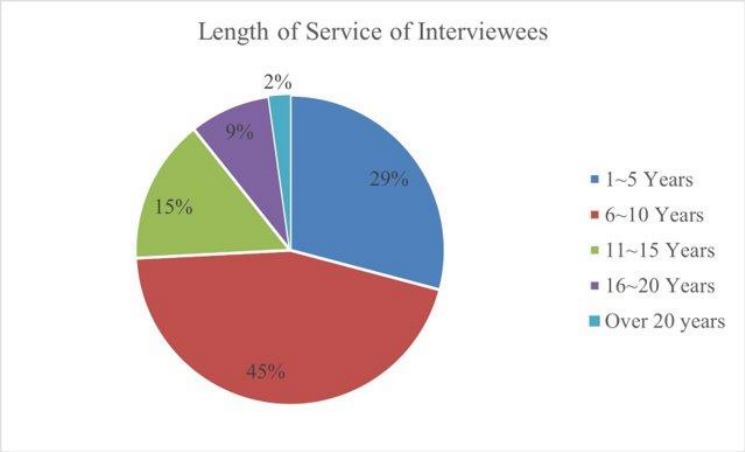


Figure 5.7: Length of service of interviewees

Figure 5.7 describes the frequencies of employees' responses based on working years with present employer, 29% have 1 to 5 years of work experience, 45% 6-10 years, 15% 11-15 years, 9% 16-20 years, and 2% over 20 years. In conclusion, the demographic data from 364 respondents reveals a uniform manner over the frequency ratio. The data also shows classic respondents are with high education and have extensive experience in current middle management positions in business, science and engineering.

5.4.3 Confirmatory factor analysis (CFA)

Confirmatory factory analysis (CFA) was used to evaluate the validity, reliability, and single dimension of the measurement model. The measurement model was evaluated in two stages, including the evaluation of individual constructs (first-order CFA) and the global measurement model (second-order CFA).

5.4.3.1 CFA results for reliability and validity of boundary spanning mechanisms

The validation of scale is a crucial component of all research. Empirically, it is difficult to ensure the soundness of research without determining the reliability and validity of the scale (Sureshchandar et al., 2002). Additionally, collecting data from different countries using a borrowed instrument is a very complicated phenomenon. In this course, the researcher can anticipate a variety of complications such as the quality of the factor structure and low construct validity.

In the scale validation phase, the unidimensionality and validity test was performed. The reliability and validity of the scale are associated with the unidimensionality of the scale (Anderson and Gerbing, 1991). Most importantly, a unidimensional measure fits with the data reasonably well, showing the low measurement error and measure what it intent to measure (McDonald, 1981). In this study, unidimensionality test is performed due to two important reasons. Firstly, to examine the measurement errors and eliminate weak factor loadings and secondly, to check the adequacy of the model through re-specified model and measure reliability. For this purpose, the researcher specified the measurement model for each construct by processing the survey data in the statistical package IBM AMOS v26 with maximum likelihood estimation method. Then the findings of unidimensionality test using a confirmatory factor analysis of are summarised.

The knowledge mobilisation measurement model includes three factors (boundary spanners, boundary objects and boundary interactions). Initial CFA run with the entire construct and then

respecified measurement model runs with projects generated in original model.

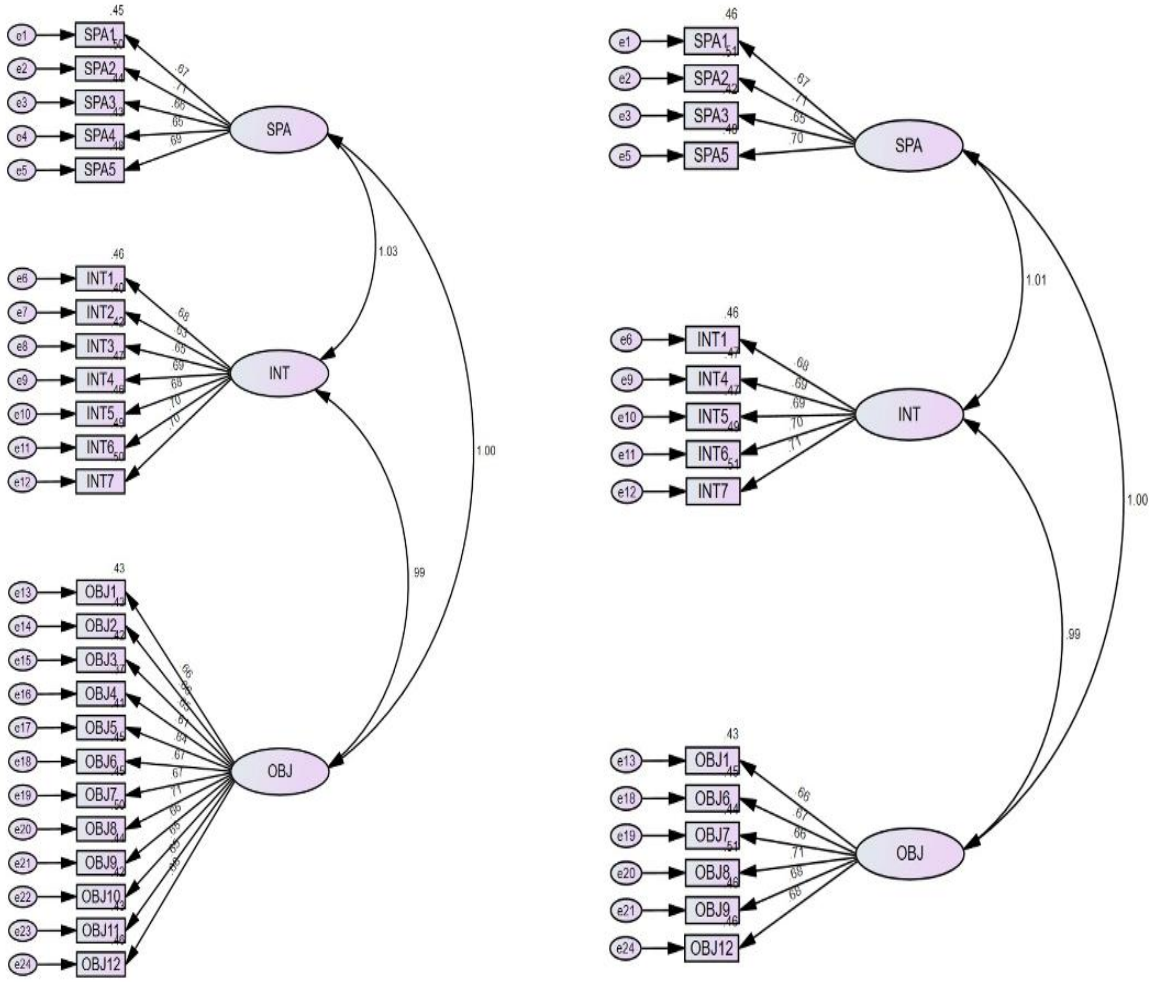


Figure 5.8: Path diagram of initiating and respecifying factor loads

As a results of initial model fit results (see Figure 5.8), nine items (i.e. SPA4, OBJ2, OBJ3, OBJ4, OBJ5, OBJ10, OBJ11, INT2, and INT3) were deleted because low factor loadings and low squared multiple correlation (all factor loadings between 0.66 – 0.93 indicated that the regression weights of all factors are statistically significant at 95 per cent confidence level). Therefore, these nine items (see Table 5.1) were removed from the structure for the next stage of analysis. In next procedure, respecified measurement model runs only those items that were generated in original model.

Table 5.1: Items deleted in original CFA

Project	Low factor load	Low SMC
SPA4: My organisation applies knowledge to key competitive requirements as well as quickly connect sources when solving problems	0.65	0.48
OBJ2: My organisation has a mechanism for translating knowledge into action plannings as well as design of new products and services	0.65	0.42
OBJ3: My organisation has policies that allow employees to come up with new thoughts as well as knowledge without fear or ridicule.	0.65	0.37
OBJ4: My organization has all forms of knowledge that are easily access to employees who want it (intranets, internet, etc.).	0.61	0.41
OBJ5: My organisation has libraries, resource centre and forums to show as well as spread knowledge	0.64	0.45
OBJ10: My organisation uses many written equipment like newsletter, instructions to keep knowledge they attract from employees	0.65	0.42
OBJ11: My organisation has distinct publications to show the captured knowledge	0.65	0.43
INT2: My organisation sends reports in time containing proper data to employees, customers, as well as related organizations	0.63	0.42
INT3: My organisation has regular seminars, speeches, meetings, as well as training classes to share knowledge	0.65	0.47

Figure 5.8 indicates AMOS path graph of both original as well as reassigned CFA estimates and factor loads. The results show that the redesignated model adequately depicts the specimen information. In particular, the regression weights (factor loads) of all variables are sufficient for their respective factor loads, as all factor loads are between 0.66 and 0.93, indicating that the regression weights of all elements are significant in statistic at the level of 95% confidence. The consequences concluded in Table 5.2 indicates the model fitting consequences of original as well as reassigned first-order CFA.

Table 5.2: Model fitting consequences according to original and reassigned models

Mode fitting indicators	Original model fitting consequences	Reassigned model fitting consequences	Model fitting threshold values (Hair et al., 2010)
Absolute fitting indicators			
Chi-square	305.209	107.319	Smaller the better
RMSEA	0.025	0.025	≤ 0.08
GFI	0.935	0.698	≥0.8
Comparative fit indices			
AGFI	0.921	0.948	≥0.8
CFI	0.986	0.992	≥0.8
TLI	0.985	0.990	≥0.8
NFI	1.226	0.958	≥0.8
Parsimonious fit indices			
CMIN/DF	1.226	1.234	$\chi 2/df < 3.0$

The results summarised in Table 5.2 shows l, the value of chi-square ($\chi 2 = 107.319$) of reassigned model compared with the value of chi-square ($\chi 2 = 305.209$) of original measurement model shows boundary spanning mechanisms fit very well into the data. Harrington (2008) pointed out that the Chi-square value was sensitive to sample size. Therefore, the ratio of chi square to degree of freedom ($\chi 2/df$) is usually applied to compensate for differences in consequences. The results indicated that $\chi 2/df = 1.234$ of the reassigned model also indicated that the model was significant in statistic at * P <.000.

In some cases, however, $\chi 2$ does not report an accurate estimate of the model fit, or the fit statistics cannot illuminate conceptual views that can construct fit assumptions between model and population, and then usually consider another fit statistic. Thus, RMSEA contained in the

Table 5.2. In generally, RMSEA is the most vital model fitting statistics applied as an option for accurate evaluation of model fitting. In this model, consequences of RMSEA = 0.025 also uncover the adequacy of element structure of the knowledge mobilisation measurement at 95% confidence interval.

The results of comparative fitting indexes in Table 5.2 show that the reassigned model fits well in all aspects, and the values of estimation, such as CFI=0.992, TLI=0.990 as well as NFI=0.958, lag behind the threshold limits. Therefore, the consequence implies the one-dimensional nature of the factor structure.

As follows, analysis as well as result of measurement models in boundary spanning mechanisms along with the validity results are summarised. The element indexes of first order elements SPA, OBJ as well as INT are successive and indexes of the second order element KMob. The potential aim of CFA model with a second order element (see Figure 5.9) is to test convergent as well as difference validity. In the model, SPA is tested with SPA1, SPA2, SPA3 and SPA5; INT is tested with INT1, INT4, INT5, INT6 and INT7; OBJ is tested with OBJ1, OBJ6, OBJ7, OBJ8, OBJ9 and OBJ12. Further, the second-order factor KMob is tested with SPA, OBJ and INT.

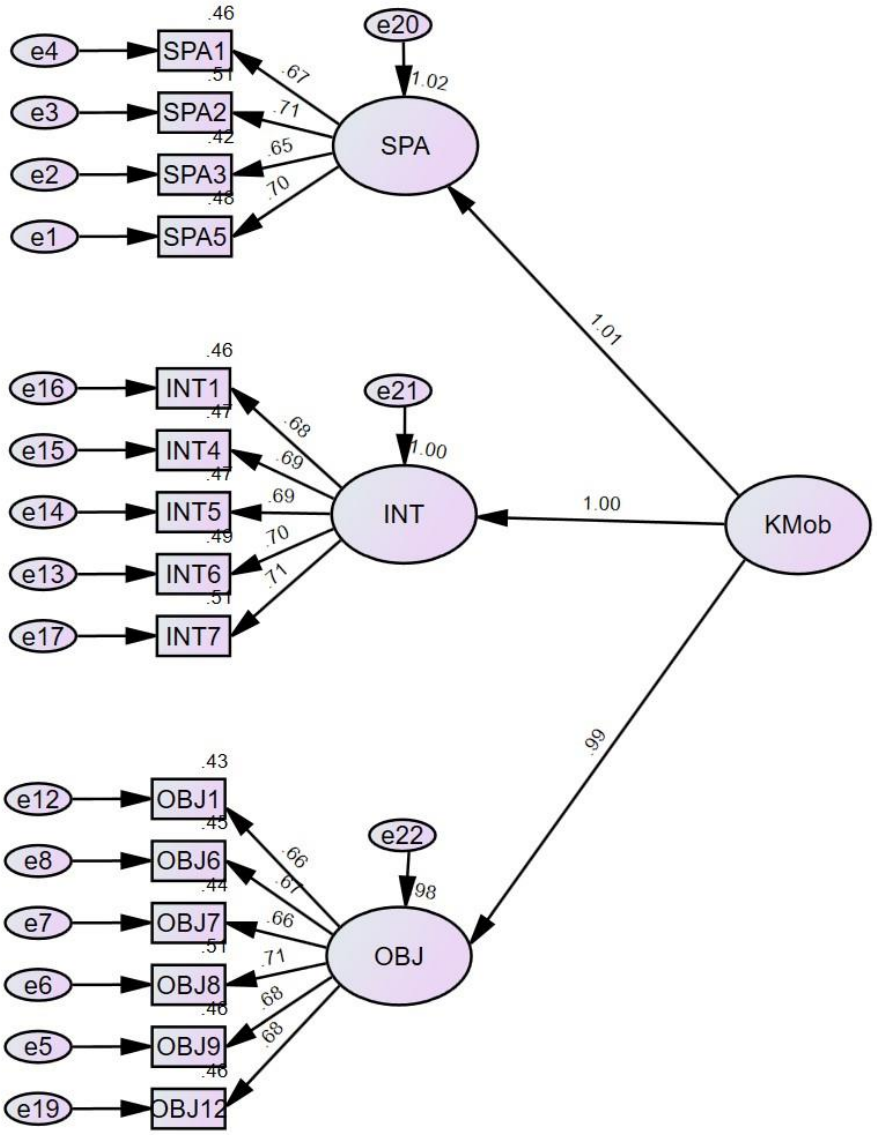


Figure 5.9: Path diagram with element loads of KMob scale

The consequences showed in Table 5.3 indicates boundary spanning mechanisms model. Such as, the model fitting consequence of the chi-square ($\chi 2 = 107.319$) shows boundary spanning mechanisms establish fitting information rationally well. The chi-square to degree of freedom ratio ($\chi 2$/ DF = 1.234) showed second-order CFA model was significant in statistic when * P <.000.

Table 5.3: Model fitting consequences of second order CFA model

Mode fitting indicators	Second order CFA model fitting consequences	Model fitting threshold values (Hair et al., 2010)
Absolute fitting indicators		
Chi-square	107.319	Smaller the better
RMSEA	0.025	≤ 0.08
GFI	0.962	≥0.8
Comparative fitting indicators		
AGFI	0.948	≥0.8
CFI	0.992	≥0.8
TLI	0.990	≥0.8
NFI	0.958	≥0.8
Parsimonious fit indices		
CMIN/DF	1.234	$\chi 2/df < 3.0$

The fitting comparison statistics of level 2 CFA showed that all aspects were well fitted. All the valuations, such as NFI = 0.958, TLI = 0.990 and CFI = 0.992 hanged behind the threshold limit. Generally speaking, the model fitting consequences of the second-order CFA model have a rational fitting to data.

5.4.3.2 CFA results for reliability and validity of lean performance

Like boundary spanning mechanisms measurement, uni-dimensionality analysis of lean performance is presented in two procedures. Firstly, original first order CFA run with every lean performance KPIs indices. Secondly, reassigned measurement models run just with those projects generated in original model. Lean performance KPIs contains five elements: inventory reduction (INV), quality assurance (QUA), cycle time or lead time reduction (TIM), on time delivery (DEL) and smooth operation flow (SMO). Table 5.4 showed four indexes (QUA3,

TIM3, SMO2 and DEL2) that need to be deleted from construct because of low factor loads as well as the relevant low squared multiple correlation (all factor loadings between 0.66 – 0.93 indicated that the regression weights of all factors are statistically significant at 95 per cent confidence level). In following procedure, reassigned measurement models run with just those items generated in original model.

Table 5.4: Items deleted in original CFA

Project	Low factor loading	Low SMC
QUA3: My organisation performs very well in shelf life management	0.64	0.41
TIM3: My organisation performs very well in executing value engineering and value	0.62	0.46
SMO2: My organisation has performed pretty well in its ability to gather customer needs, gather information about available resources, as well as balance needs and resources to decide plans as well as resource gaps.	0.65	0.50
DEL2: My organisation is doing pretty well in terms of shipping routes, choosing carriers, shipping products, and receiving and verifying products at customer sites.	0.63	0.39

Figure 5.10 indicates AMOS path graph of both original and reassigned CFA estimates as well as element loads. It is showed that the re-assigned model adequately describes the sample data since all factor loadings between 0.66-0.93.

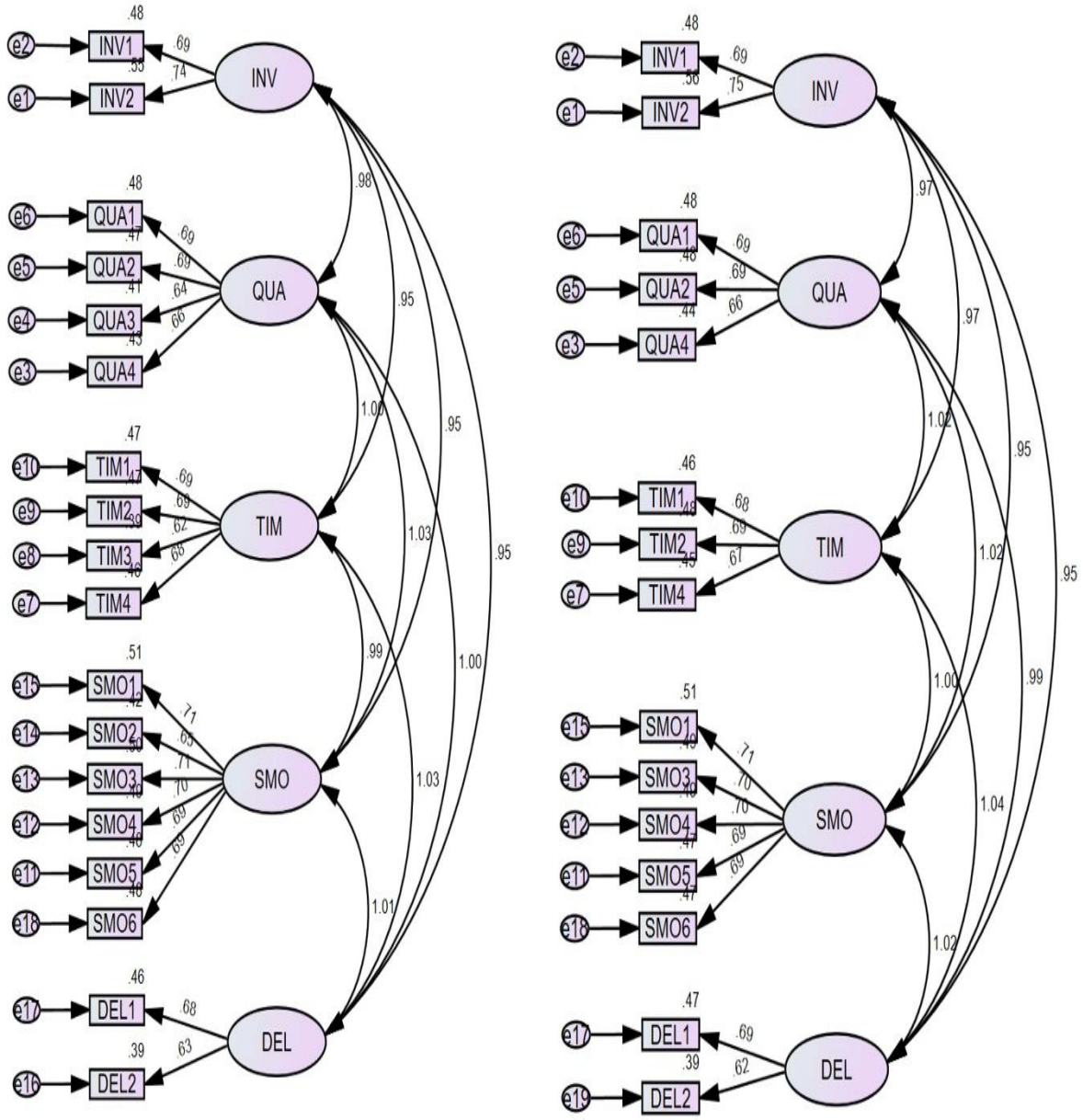


Figure 5.10: Path diagram of original and reassigned factor loads

The consequences concluded in the Table 5.5 indicates the model fitting consequences for both original as well as reassigned CFA. Table 5.5 describes the value of chi-square ($\chi 2 = 103.077$) of reassigned model compared with the value of chi-square ($\chi 2 = 168.958$) of original measurement model shows lean performance KPI establish fit pretty well in data. In current model, consequences of RMSEA = 1.288 also shows adequacy of lean performance KPIs of relation at 95% confidence interval.

Table 5.5: Model fitting consequences according to original and reassigned models

Mode fitting indicators	Initial model fitting consequences	Re-specified model fitting consequences	Model fitting threshold values (Hair et al., 2010)
Absolute fitting indicators			
Chi-square	168.958	103.077	Smaller the better
RMSEA	0.031	0.028	≤ 0.08
GFI	0.696	0.644	≥0.8
Comparative fit indices			
AGFI	0.934	0.948	≥0.8
CFI	0.986	0.991	≥0.8
TLI	0.982	0.988	≥0.8
NFI	0.947	0.961	≥0.8
Parsimonious fit indices			
CMIN/DF	1.352	1.288	$\chi 2/df < 3.0$

The results of the comparative fitting index in Table 5.5 show that the re-designated model fits well in all aspects and is estimated, such as, CFI=0.991, TLI=0.988 and NFI=0.961 lag behind the threshold limits. Therefore, the consequence implies that one-dimensional nature of factor structure.

Like boundary spanning mechanisms measurement model, the measurement model for the lean performance was conducted with AMOS v26. CFA model is designed to measure the validity see (Figure 5.11). In this model, INV is measured by INV1 and INV2; QUA is measured by QUA1, QUA2 and QUA4; TIM is measured by TIM1, TIM2 and TIM4; SMO is measure by SMO1, SMO3, SMO4, SMO5 and SMO6; DEL is measured by DEL1 and DEL2. In addition,

the second-order factor lean performance is measured by INV, QUA, TIM, SMO and DEL.

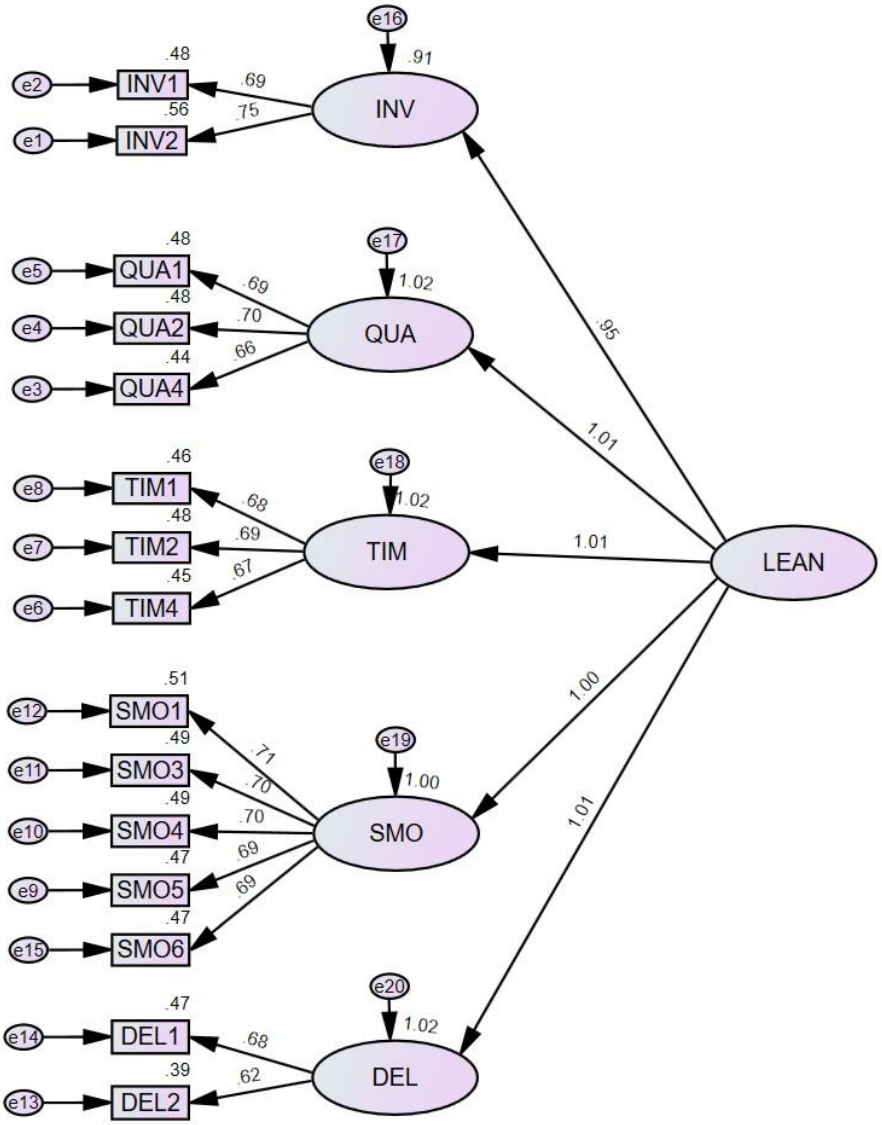


Figure 5.11: Path diagram with element loads of lean performance scale

Consequences in Table 5.6 shown lean performance model. Such as, the model fitting consequences of chi-square ($\chi 2 = 106.865$) shows lean performance establish fit data well. The chi-square to degree of freedom ratio ($\chi 2$/ DF =1.257) indicated that the second-order CFA model was significant in statistic when * P <.000

Table 5.6: Model fitting consequences of second-order CFA model

Mode fitting indicators	Second-order CFA model fitting consequences	Model fitting threshold (Hair et al., 2010)
Absolute fitting indicators		
Chi-square	106.865	Smaller the better
RMSEA	0.027	≤ 0.08
GFI	0.964	≥0.8
Comparative fitting indicators		
AGFI	0.950	≥0.8
CFI	0.991	≥0.8
TLI	0.989	≥0.8
NFI	0.950	≥0.8
Parsimonious fit indices		
CMIN/DF	1.257	$\chi 2/df < 3.0$

The comparative statistical results of the second-level CFA showed that all aspects were well fitted. All estimates such as, NFI = 0.950, NFI = 0.950, TLI = 0.989, CFI = 0.991 hanged behind the threshold limit. Generally speaking, the model fitting consequences of the second order CFA model have a rational fit to data.

5.5 Hypothesis testing using SEM

In former sections, respective confirmatory element analysis in boundary spanning mechanisms as well as lean performance instrument were applied. In the study, CFA aims to empirically verify the overall structure by ensuring how the proposed factor specification considers the matching index between the model and data (Hair et al., 2010). This study aims to survey the relationships between the elements of KMob as well as lean performance. As described by Diamantopoulos and Siguaw (2000), SEM (path analysis model) is as a proper way for hypothesis measurement. Thus, in the following sections, hypothesis consequence of

serial hypothesis (H1, H2 and H3) with SEM are concluded.

5.5.1 Hypothesis H1 – Boundary spanners & lean performance

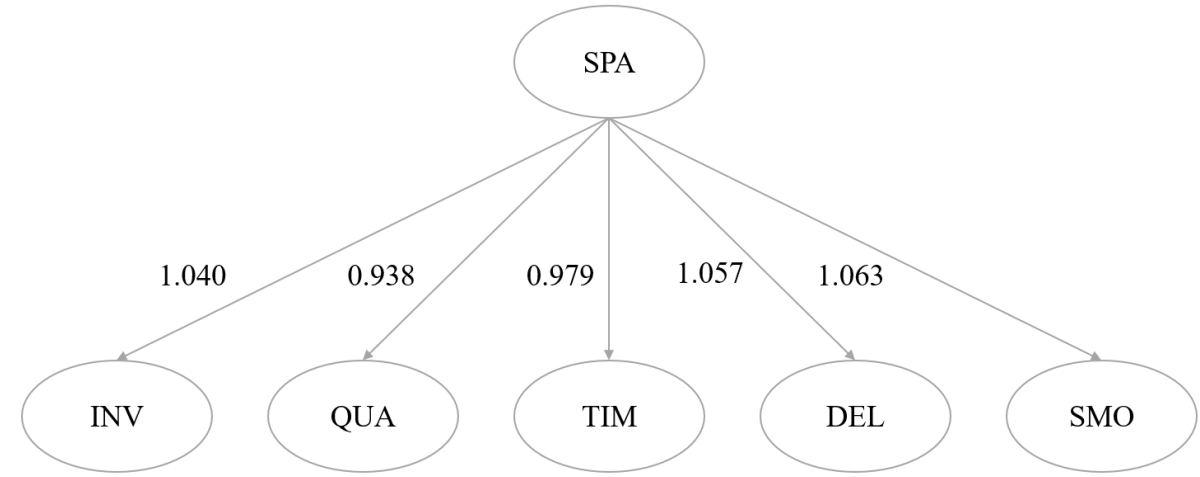
Table 5.7: Hypothesis testing results on the basis of H1

Hypothesis	Path	Gamma (γ)	[a]*t*-Value	[b]*p*-Value	Result
H1	SPA ---> INV	1.040	15.128	.000	Supported
	SPA ---> QUA	0.938	14.204	.000	
	SPA ---> TIM	0.979	13.667	.000	
	SPA ---> DEL	1.057	14.048	.000	
	SPA ---> SMO	1.063	14.264	.000	

[a]t > 1.96

[b]p < 0.05

Sources: Hu and Bentler (1999), Browne and Cudeck (1993)



As showed, hypothesis H1 according to assumed boundary spanners may be a factor of lean performance within the context of agri-food supply chains. Table 5.7 shows structural relation among the exogenous (independent) as well as endogenous (dependent) variables. In the path analysis model, arrows point from exogenous variables (SPA) to five endogenous variables (INV, QUA, TIM, DEL and SMO). In mathematics, the strength of paths may be decided

through the values of gamma (γ) as well as beta (β). Higher values of gamma (γ) as well as beta (β) value show the strength of relation between exogenous (independent) and endogenous (dependent) variables.

As shown in Table 5.8, structural relationship between boundary spanners and five lean performance KPIs is evident at p-value < 0.05. The boundary spanners had an evident effect on lean performance. The effect of boundary spanners on five lean performance (SPA ---> INV: $\gamma = 1.040$, $t = 15.128$, p-value < 0.01), (SPA ---> QUA: $\gamma = 0.938$, $t = 14.204$, p-value < 0.01), (SPA ---> TIM: $\gamma = 0.979$, $t = 13.667$, p-value < 0.01), (SPA ---> DEL: $\gamma = 1.057$, $t = 14.048$, p-value < 0.01) and (SPA ---> SMO: $\gamma = 1.063$, $t = 14.264$, p-value < 0.01) shown to be evident.

5.5.2 Hypothesis H2 – Boundary objects & lean performance

It is shown, hypothesis H1 according to assumption boundary objects may be a factor of lean performance within the context of agri-food supply chains. Table 5.8 shows structural relation among the exogenous (independent) as well as endogenous (dependent) variables. In the path analysis model, arrow points to the exogenous variable, OBJ, and points to the five endogenous variables (INV, QUA, TIM, DEL and SMO). As shown, structural relationship between boundary objects and five lean performance KPIs is significant at p-value < 0.05. There is no assumptions could be rejected. Moreover, boundary objects element had an evident effect on lean performance. The effect of boundary objects on five lean performance (OBJ ---> INV: $\gamma = 1.011$, $t = 12.564$, p-value < 0.01), (OBJ ---> QUA: $\gamma = 0.993$, $t = 14.117$, p-value < 0.01), (OBJ ---> TIM: $\gamma = 1.045$, $t = 13.840$, p-value < 0.01), (OBJ ---> DEL: $\gamma = 1.090$, $t = 13.568$, p-value < 0.01) and (OBJ ---> SMO: $\gamma = 1.100$, $t = 13.912$, p-value < 0.01) shown to be evident.

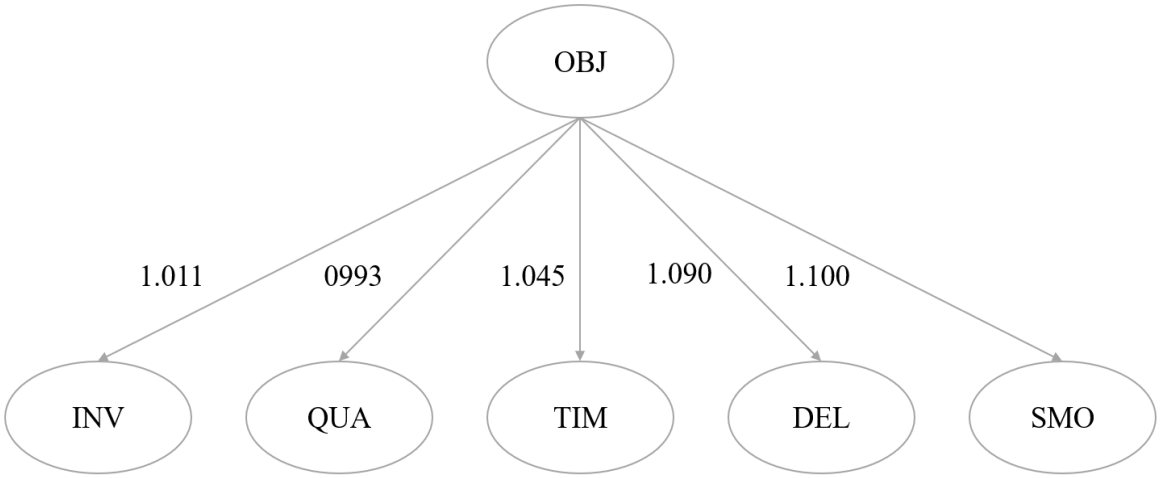
Table 5.8: Hypothesis testing results on the basis of H2

Hypothesis	Path	Gamma (γ)	[a]*t*-Value	[b]*p*-Value	Consequence
H2	OBJ ---> INV	1.011	12.564	.000	Supported
	OBJ ---> QUA	0.993	14.117	.000	
	OBJ ---> TIM	1.045	13.840	.000	
	OBJ ---> DEL	1.090	13.568	.000	
	OBJ ---> SMO	1.100	13.912	.000	

[a]t > 1.96

[b]p < 0.05

Sources: Hu and Bentler (1999), Browne and Cudeck (1993)



5.5.3 Hypothesis H3 – Boundary interactions & lean performance

It is shown, hypothesis H3 according to assumption that boundary interactions may be a factor of lean performance within the context of agri-food supply chains. Table 5.9 shows structural relation among exogenous (independent) as well as endogenous (dependent) variables. In the path analysis model, arrows start from the exogenous variable (INT) as well as enter five endogenous variables (INV, QUA, TIM, DEL and SMO).

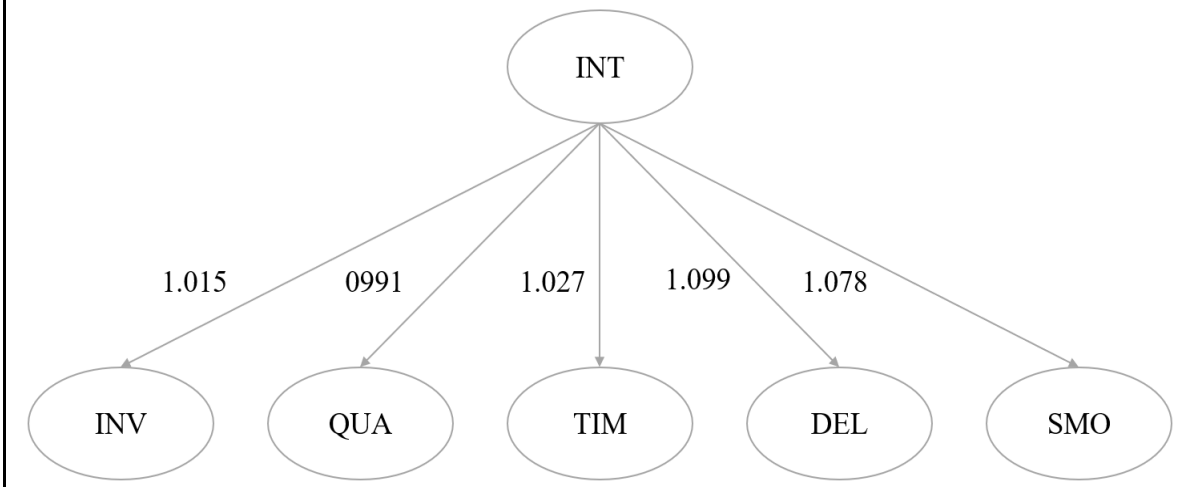
Table 5.9: Hypothesis testing results on the basis of H3

Hypothesis	Path	Gamma (γ)	[a]*t*-Value	[b]*p*-Value	Consequence
H3	INT ---> INV	1.015	12.076	.000	Supported
	INT ---> QUA	0.991	14.322	.000	
	INT---> TIM	1.027	13.674	.000	
	INT ---> DEL	1.099	13.818	.000	
	INT ---> SMO	1.078	13.735	.000	

[a]t > 1.96

[b]p < 0.05

Sources: Hu and Bentler (1999), Browne and Cudeck (1993)



As shown in Table 5.9, structural relationship between boundary objects and five lean performance KPIs is significant at p-value < 0.05. There is no assumption could be rejected. Moreover, boundary objects element had an evident effect on lean performance. The effect of boundary objects on five lean performance (OBJ ---> INV: γ = 1.015, t = 12.076, p-value < 0.01), (OBJ ---> QUA: γ = 0.991, t = 14.322, p-value < 0.01), (OBJ ---> TIM: γ = 1.027, t = 13.674, p-value < 0.01), (OBJ ---> DEL: γ = 1.099, t = 13.818, p-value < 0.01) and (OBJ --->

SMO: $\gamma = 1.078$, $t = 13.735$, p-value < 0.01) shown to be evident.

5.6 Summary

Knowledge mobilisation produces knowledge, people as well as action together with value creating. It may be thought as a system management method of making new knowledge ready for service or action to build value. This approach tries to encourage the spirit of participation and integration in organisations and discuss the system of collective thinking and the sharing of ideas extensively. Relying on techniques, capturing the knowledge of all KMob participants, saving and publishing them that is implanted in a successive circulation of learning as well as action.

This chapter tested the effect of KMob process on lean supply chain operations. A research model was promoted composed of boundary spanners, boundary objects and boundary interactions as the elements of KMob and five lean performance KPIs, i.e. inventory reduction, lead-time reduction, quality assurance, on-time delivery and smooth operation flow, to assess lean supply chain operations. The suggested model was measured via an empirical research of agriculture supply chains. Findings (see Figure 5.12) suggest that the KMob has an active as well as evident effect on lean supply chain operations. Additionally, results indicate that among the three KMob elements, boundary objects and boundary interactions are relatively more vital since they have a higher element loading. Results suggest the boundary interaction is considerably stronger than that of boundary objects and spanner as well since it has a higher significant level.

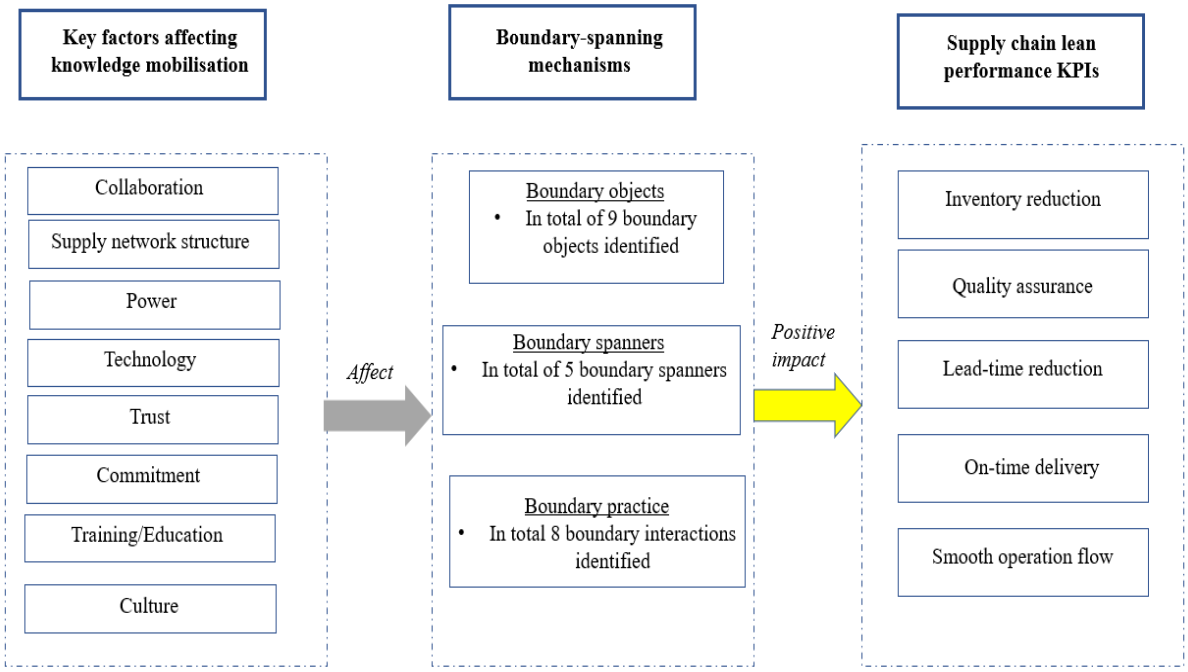


Figure 5.12: The validated KMob framework

Accordingly, in practical, it is recommended that knowledge mobilisation as a management method is quickly welcomed by business and supply chain managers. For improving lean performance of their supply chain operations, managers should improve abilities of KMob process. They can carry out a self-evaluation of KMob process to distinguish weakness as well as areas to be enhanced then develop proper practices to refine them since KMob is relatively more efficient in improving lean supply chain operations. On the other hand, one of the main results of chapter 5 is the significant impact of boundary object and interaction on the relationship between KMob and lean performance. It suggests that the managers should pay real attention to the use of artefacts or knowledge objects as crucial components of KMob processes. Therefore, when designing KMob practices, managers would be aware of the role of artefacts and include them into the improvement of supply chain performance and related infrastructures. In addition, according to Parcell (2010), dealing with the knowledge mobilisation issue is fundamental to best utilising knowledge channels' traceability. Therefore, managers should make most use of communication interactions, that is, by adopting efficient

policies related to lean practices, including documentation of experiences, optimisation of reward schemes, and the increase of available knowledge resources for employees, etc. Such a way may be applied to justify another KMob-involved investment of the organisation too. In a word, directors could obtain better consequences of KMob by using boundary objects and interactions that support lean operations and provide a collaborative environment within the entire supply chain.

Chapter 6 Discussion

6.1 Introduction

This chapter will discuss the empirical findings from both qualitative and quantitative phases in relation to relevant literature, and the evolution of the KMob framework from conceptual (developed in Chapter 2 based on literature review) through empirical phase (i.e. the empirical KMob framework developed in Chapter 4) to the validated KMob framework (from Chapter 5). Many findings of this study are in line with that in literature, but some do not support existing work in which case, possible reasons are explained to stimulate debate and further discussion. This study used a mixed methods approach to develop a knowledge mobilisation framework dedicated to crossing supply chain boundaries in agri-food industry and validated it by assessing its impact on supply chain lean performance. Specifically, the qualitative phase of the empirical study collected data from five countries across Europe and South America using semi-structured interviews. The findings from the qualitative phase include key factors affecting knowledge mobilisation in supply chains and boundary-spanning mechanisms. During the quantitative phase of the empirical study, survey questionnaires were distributed to wide supply chain stakeholders and over 300 valid questionnaires were returned. The collected data were analysed using Structural Equation Modelling (SEM) method. The findings from the quantitative phase confirmed the positive impacts from the three categories of boundary-spanning mechanisms (i.e. boundary objects, boundary spanners and boundary interactions) to supply chain lean performance (with five specific KPIs considered, namely inventory reduction, quality assurance, lead-time reduction, on-time delivery and smooth operations flow). The next section (i.e. Section 6.2) will have a look at the evolution of conceptual KMob framework to empirical KMob framework, and Section 6.3 reflects the evolution of empirical KMob framework to validated KMob framework. Empirical findings are compared with relevant

literature where appropriate, in particular about the key factors affecting knowledge mobilisation and boundary-spanning mechanisms to cross knowledge boundaries in supply chains. Finally, a short summary is provided in Section 6.4.

6.2 Evolution of the knowledge mobilisation model from conceptual to empirical stage

This section will discuss how the KMob framework has evolved from the conceptual stage to empirical stage. The conceptual KMob framework was developed in Chapter 2 via an SLR. The empirical KMob was developed in Chapter 4 via qualitative phase of the empirical study. Figure 6.1 Compares the two frameworks and highlights the main differences and similarities between the two frameworks. The top part of the Figure 6.1 illustrates the building blocks and their key elements of the conceptual KMob framework. The bottom part of the Figure illustrates the building blocks and their key elements of the empirical KMob framework. In the Figure 6.1, the white boxes represent the elements remain the same in both conceptual and empirical KMob frameworks, greyed boxes represent the elements that appeared in the conceptual KMob framework but disappeared from the empirical KMob framework, yellow colour highlights the elements that have been modified from the conceptual framework and enriched in the empirical KMob framework, and green colour highlights completely new elements in the empirical KMob framework (i.e. the elements did not exist in the conceptual KMob framework).

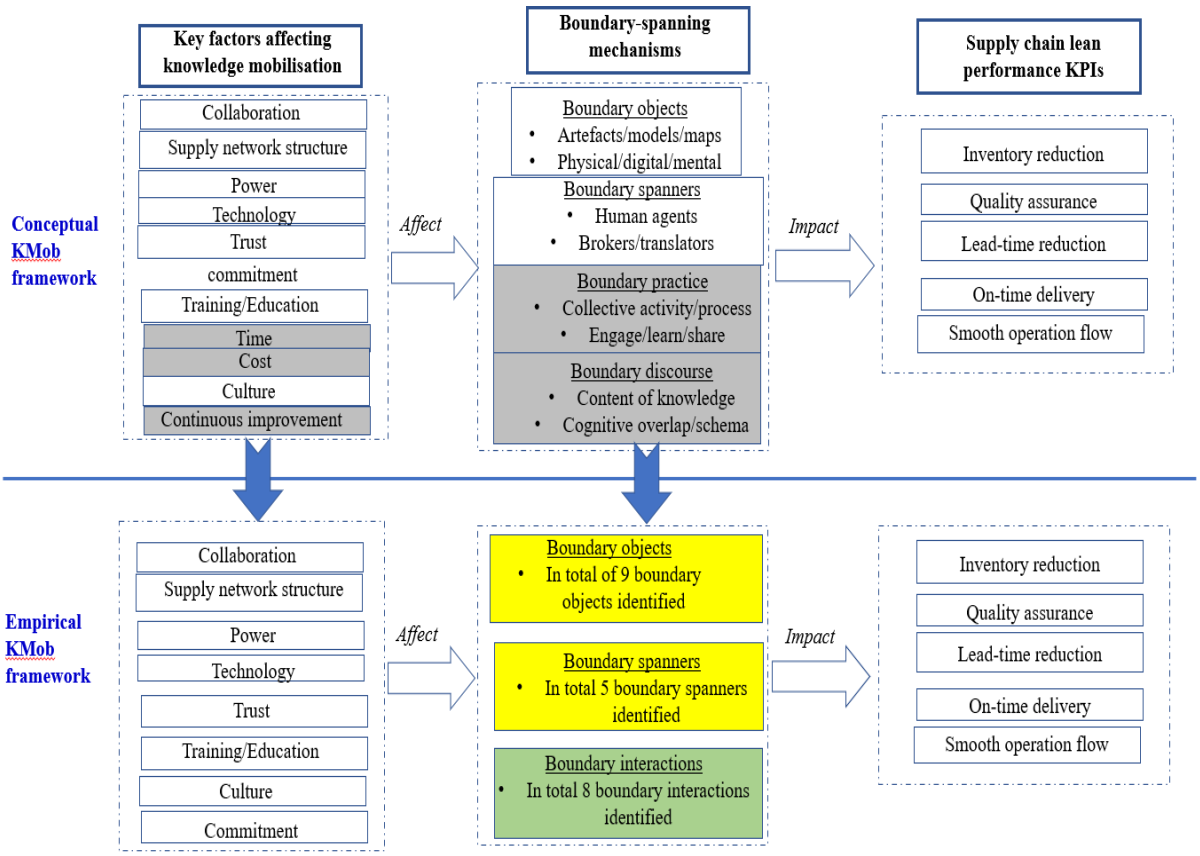


Figure 6.1: Evolution of conceptual KMob framework to empirical KMob framework

As can be seen clearly from the Figure 6.1, both conceptual and empirical KMob frameworks have the same three building blocks: (1) key factors affecting knowledge mobilisation, (2) boundary-spanning mechanisms, and (3) supply chain lean performance KPIs. By comparing the two frameworks, it is easy to see that there are big differences for the first two buildings, while building block 3 remains unchanged. The building block that changed the most from conceptual to empirical KMob framework is "Boundary-spanning mechanisms". These changes will be discussed in detail below.

In the conceptual KMob framework, there are four categories of boundary-spanning mechanism, namely boundary objects, boundary spanners, boundary practice and boundary discourse. None of the four categories remained the same when the framework evolved to empirical stage. Firstly, empirical data could not support the categories of "boundary practice" and "boundary discourse", hence these two categories disappeared from the empirical KMob

framework. One possible reason for “boundary practice” to disappear is that this study is focused on agri-food supply chains where final products are usually quite simple in terms of product structure, while the concept of “boundary practice” was originally coined in manufacturing industry where more complex products are designed and created. In agri-food supply chain, there is not so much “design” of products as most agricultural products exist in one whole piece. For example, tomatoes or lettuce are produced in one field and cannot be decomposed into smaller parts and produced as parts separately in different fields. However, in manufacturing industry, products such as a car or an aeroplane can usually be decomposed into dozens, hundreds or even thousands of small parts. The individual parts can be, and often are, produced separately in different workshop floors, factories or even different companies. It is usually normal practice that people with different knowledge or expertise can come together to collaboratively design and develop a car or an aeroplane. During the collaborative practice, people share and transfer knowledge to each other. Sometimes new knowledge can be created too. That is exactly the scenario in which Paul Carlile first coined the term “knowledge practice” when he studied knowledge sharing in product design and development (Carlile, 2004; Liu, 2020). In the agri-food supply chains, it is a lot more difficult to organise shared practice and use “boundary practice” to mobilise knowledge, because more activities in the supply chain, especially the farming activities, can be at a small scale. Many farms are family owned, family run SMEs (Zhao et al, 2020), but they are sufficient to produce a certain amount of tomatoes or lettuce to the best of their capacity without needing co-production from other farms or supply chain partners. It is also the case that many small farms are scattered around the countries or regions or the world quite widely. There could be significant distances between them. Having people together to undertake shared practice is not common in agri-food industry. For this reason, the empirical data do not support the “boundary practice”, hence the category of the mechanism is not included in the empirical KMob framework.

“Boundary discourse” has always been a tricky concept. During the interviews with agri-food supply chain stakeholders at the empirical stage, the conceptual of “boundary discourse” was rejected by almost all interviewees. They commented that the term was far too academic and abstract, and difficult to make any practical sense in agri-food daily operations. The author was advised not to use the term, otherwise interviewees who were not educated to college or university level found difficult to understand what the term actually meant, hence would not be able to respond to the interview question. It is the same opinion from interviewees across Europe and South America. Based on this, “boundary discourse” is also not included in the empirical KMob framework. That is why both “boundary practice” and “boundary discourse” are in grey colour in the conceptual KMob framework, representing that they do not exist in empirical KMob framework.

The author did feel that there was a need not to lose the mechanisms derived from practice and discussion activities for crossing knowledge boundaries, after taking into suggestions from interviewees, a new category of boundary-spanning mechanism was created, which was called “boundary interactions”. This new term was welcomed by agri-food supply chain stakeholders, because they thought that it was unambiguous, easy to understand and it took place often in their everyday practice. Furthermore, in total of eight specific elements of “boundary interactions” were identified during the qualitative phase of the empirical study. They are face-to-face meetings, video conferences, fieldwork, online/onsite forums, focus groups, learning sessions, training programmes, and stakeholder engagement events. All eight types in “boundary interactions” received strong support from empirical data, hence the new category of boundary-spanning mechanism has been added to the empirical KMob framework. This new category of boundary-spanning mechanism is one of the key contributions from the qualitative phase of the empirical study. It should be mentioned that even though the category as a whole is newly identified as a mechanism for crossing knowledge boundaries in the agri-food supply

chain, some of the elements such as face-to-face meetings and fieldwork have been well practised for very long time in other contexts (Boshkaska, Liu & Chen, 2018). This PhD work has theorised the empirical findings to make clear contribution to new knowledge.

The terms of the other two categories of boundary-spanning mechanisms, "boundary objects" and "boundary spanners", are kept the same in both conceptual and empirical KMob frameworks, however these two categories have been significantly extended from the conceptual framework and enriched via empirical study, hence the meanings of the two categories in the empirical KMob framework are greatly substantiated. In literature, the two categories of the boundary-spanning mechanisms are fairly generic, in wide scope (not used in agri-food supply chains specifically) and with very limited number of specific elements of each category (Carlile, 2004; Jashapara, 2011; Liu, 2020). In this study, nine specific elements have been discovered for the category of "boundary objects" that were actually used by agri-food supply chain stakeholders in their knowledge mobilisation exercise. The nine elements are websites, PowerPoint presentations, information technology infrastructure, databases, guidelines, newsletters, education packages, sketches and diagrams, and documentations. Individually, most of these elements can be traced back to manufacturing industry for people to achieve shared understanding in product design and development. For example, sketches have been used for centuries in product design to visualise ideas by individuals, groups and project teams, but traditionally were not considered as a knowledge mobilisation mechanism, especially not used to cross knowledge boundaries across supply chains (Chen, Liu & Oderanti, 2018).

Furthermore, this study identified five specific elements for the category of "boundary spanners", including knowledge brokers who have hybrid professional roles, knowledge workers who have a deep background in education and experience in an organisation, top managers, mid-level managers and junior-level managers in an organisation, internal

facilitators (i.e. knowledge mobilisation associates), and external facilitators (i.e. management consultants). “Knowledge spanners” has been a concept that caught a lot of attention in literature but was not well substantiated in practice. One of the reasons could be that in abstract sense, it is not difficult to design a “knowledge spanner” in an organisation because it is true that some people have double or triple roles in different departments or project teams. However, when you scale this concept up to supply chain context, it is actually not often you will find a person who have roles in different companies or organisations, because that is considered as a risk in many situations. It is a lot more difficult to have double role or triple role kind of knowledge spanners in a supply chain, hence there are not a lot of empirical findings that support the category of “knowledge spanners” (Zhao et al, 2021). Comparatively, there is something very special in agri-food supply chains which is called “cooperative”. It means that many farms (especially SMEs) can form a bounded collaboration with other farms and other partners in the downstream of the supply chain, in order to make sure that they will be in a reliable and long-time partnership, have a powerful voice in the industry to influence policy makers, so that the products produced on the farms can be sold and not wasted (Chen, Liu & Oderanti, 2018). Also, some farms will get advice or financial loans from the co-operatives in order to undertake their farming activities to avoid relevant risks. In many countries, the author has been told successful stories about “co-operatives”. In this case, some people in the “co-operatives” will become de facto knowledge spanners, because they spend time on clusters of farms, understand food production, food harvesting, distribution and marketing the products (Chen, Liu & Oderanti, 2018). This is why the category of “knowledge spanners” has received strong support from the empirical data, hence it is a type of boundary-spanning mechanism that has been extended from the conceptual KMob framework to go into the empirical KMob framework.

6.3 From the empirical to validated KMob framework

The empirical KMob framework developed from Chapter 4 was then applied to the agri-food supply chain lean management for validation purpose. During the validation process, the investigation is focused on testing the impact of each of the category of the boundary-spanning mechanisms on the five supply chain lean performance KPIs. Based on empirical data collected via over 300 valid survey questionnaires which were then analysed using Structural Equation Modelling (SEM) method, the validated KMob framework established quantified relationships for the "impact" arrow connecting the second (i.e. boundary-spanning mechanisms) and third (i.e. supply chain lean performance) building blocks in the framework. Figure 6.2 shows how the KMob framework evolved from empirical to validated status.

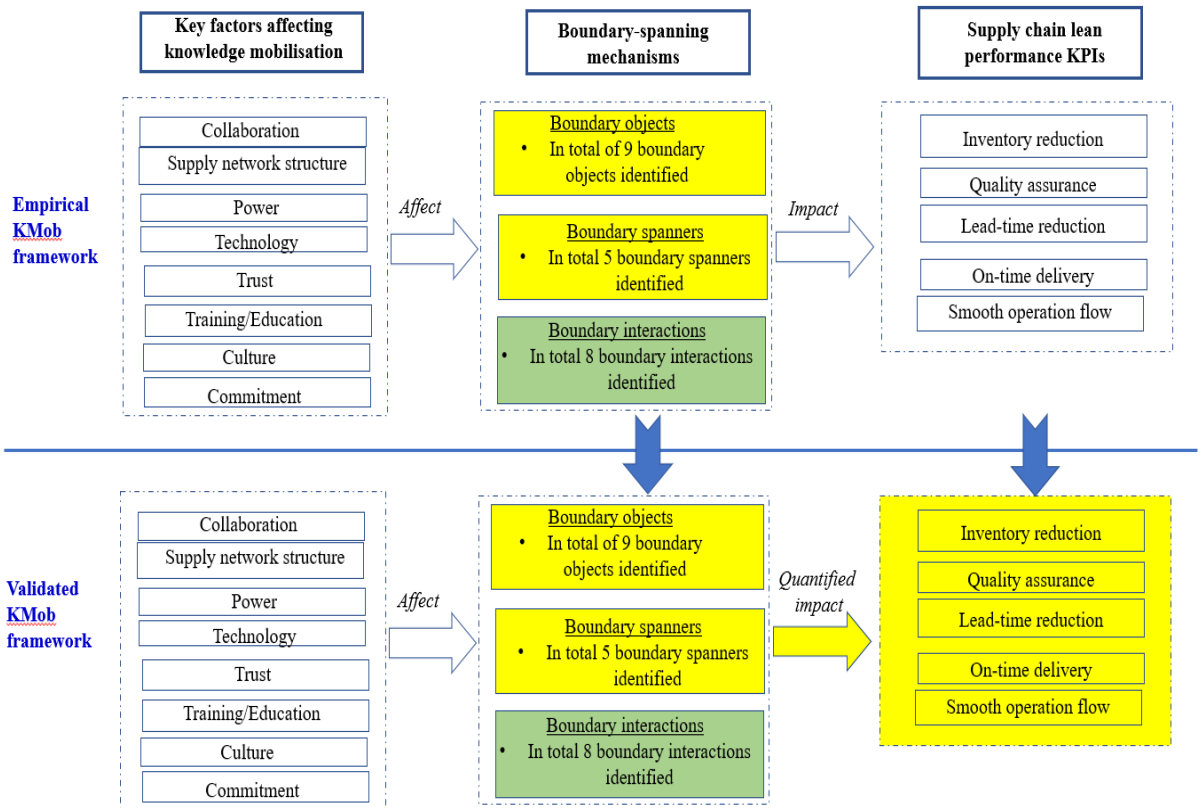


Figure 6.2: KMob framework from empirical to validated stage

As can be seen clearly from Figure 6-2, the main evolution during this stage involves only the second building block (i.e. boundary-spanning mechanisms) and the third building block (i.e. supply chain lean performance KPIs). No changes were made to the first building block (i.e.

key factors affecting knowledge mobilisation).

Details of the quantified relationships between each of the three categories of boundary-spanning mechanisms (i.e. boundary objects, boundary spanners and boundary interactions) and each of the five supply chain lean performance KPIs (i.e. inventory reduction, quality assurance, lead-time reduction, on-time delivery and smooth operations flow) are provided in Section 5.5. The empirical data supported the positive relationships for all three hypotheses and all five variables (i.e. KPIs in SEM analysis) with significance. These findings are important because they have provided proof that boundary objects, boundary spanners and boundary interactions have practical, positive impact on lean performance on various dimensions, from inventory reduction to lead-time reduction, from smooth operations flow to on-time delivery, and on quality assurance. These relationships were not established in literature before (Shakerian, Dehnavi & Shateri, 2016), that is, they were quantified for the first time in this PhD study, hence no directly comparisons can be made between the empirical findings and literature.

6.4 Summary

This chapter reflects the journey from the conceptual through empirical to validated KMob framework. Section 6.2 has detailed the evolution of the conceptual KMob framework to empirical Mob framework, and Section 6.3 discussed that of empirical KMob framework to validated KMob framework. The following Figure 6.3 summaries the changes between the conceptual KMob framework and the validated KMob framework. The changes are illustrated using colours:

- Greyed boxes: elements removed from the Conceptual KMob framework based on empirical data. Three key elements in the first building block (i.e. continuous improvement, time and cost) and two boundary-spanning mechanisms from the second

building block (i.e. boundary practice and boundary discourse) in the conceptual KMob framework have been omitted in the validated KMob framework.

- Yellow colour: highlighting elements and relationships modified and substantiated from the conceptual to validated KMob framework, including two categories of boundary-spanning mechanisms in the second building block. The relationship between the second (i.e. boundary-spanning mechanisms) and third (i.e. supply chain lean performance) building blocks have been quantified in this study, hence these two building blocks are both in yellow.
- Green colour: highlighting new elements in the validated KMob framework, that is, "boundary interactions" in the second building block (i.e. boundary-spanning mechanisms).

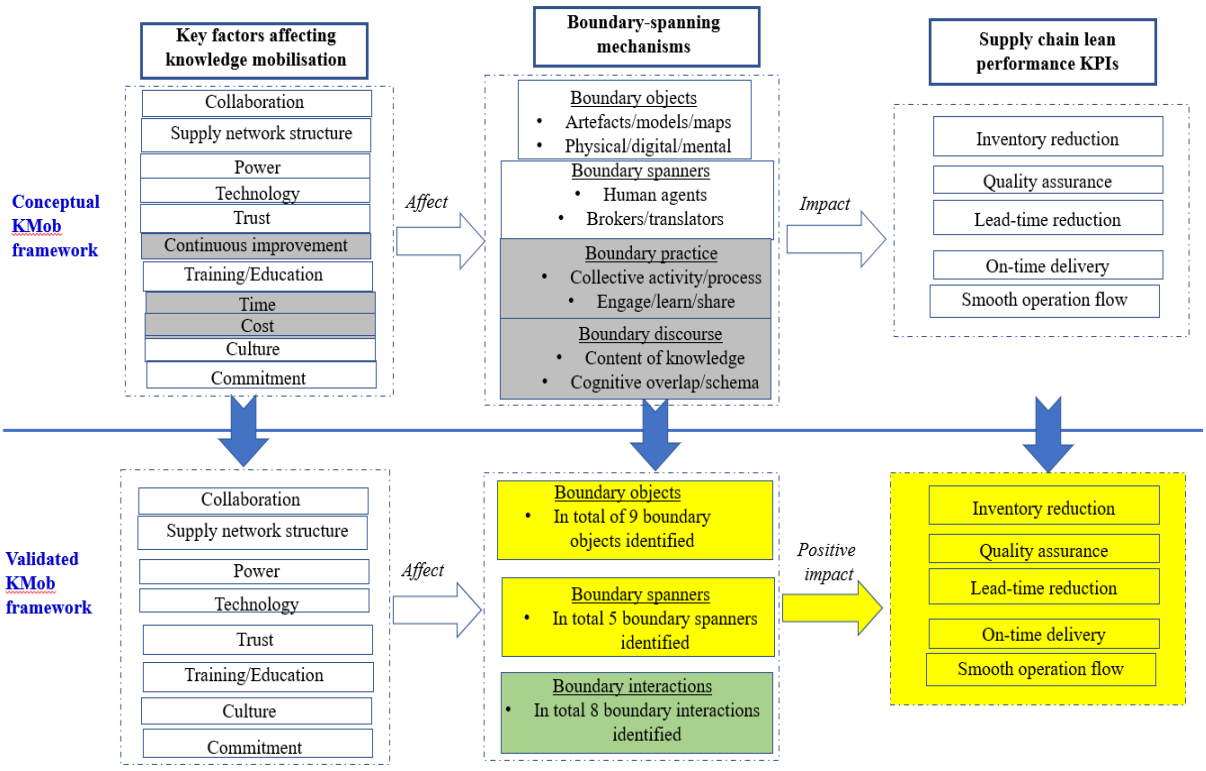


Figure 6.3: Summary of evolution from conceptual to validated KMob framework

Chapter 7 Conclusions

7.1 Introduction

This study investigated how to cross knowledge boundaries to effectively mobilise knowledge in order to help improve lean performance in agri-food supply chains. This chapter draws conclusions across all stages of the projects, in other words, it shows how the three research questions (defined in Chapter 1) were answered through empirical study of both qualitative (Chapter 4) and quantitative phases (Chapter 5), and how the knowledge gaps (identified in Chapter 2) were filled through key contributions of this study by adopting a mixed-method approach (Chapter 3). Moreover, this chapter will highlight the theoretical contributions and management implications of the findings, identify limitations of the study and make suggestions for further research in the area.

7.2 Conclusions across all stages of the project

It is important to have the overall picture of the project by explicitly eliciting the links across all stages of the project, in order to clearly describe how the three research questions defined in Chapter 1 have been answered by the end of Chapter 5. Figure 7-1 illustrates the links established among different stages of the project and how the knowledge gaps are bridged via the study.

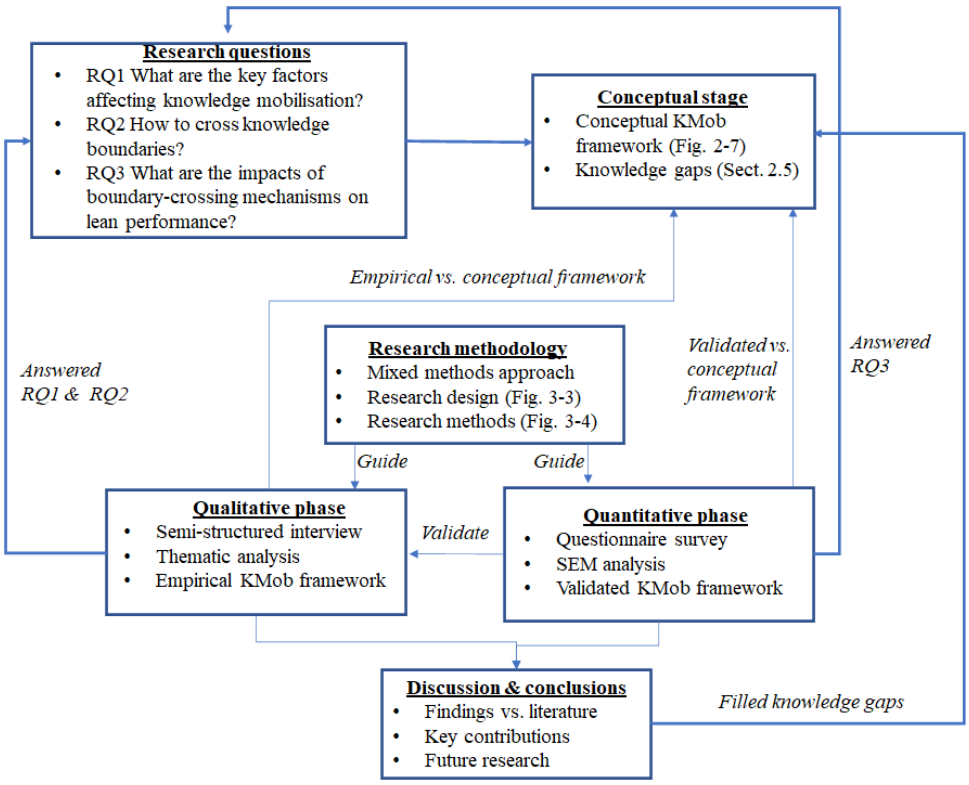


Figure 7.1: Links across all stages of the project

As can be seen from the Figure 7.1, the three research questions have been formulated at the beginning of the project, then conceptual stage was conducted to systematically review relevant literature, identify research gaps and propose a knowledge mobilisation conceptual framework. Then the research methodology was devised which included a number of key elements: the mixed-method approach, the research design (process point of view), and the choices and justification for data collection and analysis methods. The research methodology provided guidance for the empirical stages consisting of a qualitative phase and a quantitative phase. The findings from the qualitative phase provided answers to two research questions (i.e RQ1 and RQ2), and findings from the quantitative phase provided answers to the third research question (i.e. RQ3). Findings from both conceptual stage and empirical stage were then discussed and links were made from empirical findings to relevant literature, before conclusions of the study could be drawn.

To recap, the three research questions defined at the beginning of the project are:

- RQ1. What are the key factors affecting knowledge mobilisation in agri-food supply

chains?

- RQ2. How to cross knowledge boundaries (i.e. by using what boundary spanning mechanisms) in agri-food supply chains?
- RQ3. What is the impact of the boundary spanning mechanisms on agri-food supply chain lean performance?

These three research questions have been fully answered after the combination of conceptual and empirical study. The outcome of the conceptual stage is a knowledge mobilisation conceptual framework which sets up the architecture for knowledge mobilisation. In the conceptual framework (Figure 2-7), there are three main building blocks: key factors affecting knowledge mobilisation, boundary-spanning mechanisms and supply chain lean performance. Based on a systematic analysis of 81 papers (that were include in the SLR in Chapter 2), eleven key factors were identified. They are: collaboration, supply network structure, power, technology, trust, commitment, training/education, time, cost, culture and continuous improvements. In Chapter 4 (i.e. the qualitative phase of the empirical study), majority of these key factors were confirmed by the findings from the thematic analysis of the data from the semi-structured interviews. However, three of the factors (i.e. commitment, time and cost) disappeared and left with eight key factors. Details of the empirical findings were shown in Figure 4-?. Hence, RQ1 has been answered from both literature analysis and qualitative phase of the empirical study. The comparisons of answers to RQ1 between the literature review and empirical study was discussed in Chapter 6.

RQ2 was answered also via two stages: conceptual stage in Chapter 2 and qualitative phase of the empirical stage in Chapter 4. After the SLR, four types of boundary-spanning mechanisms were identified in the knowledge mobilisation conceptual framework (Figure 2-7). During the qualitative phase of the empirical study, based on thematic analysis of the data collected from semi-structured interviews, three types of boundary-spanning mechanisms were identified.

Two of them are the same types as from literature analysis: boundary objects and boundary spanners. One new category of boundary-spanning mechanism was added, which was termed "boundary interactions". Boundary interaction can be seen as the fusion of boundary practice and boundary discourse, but is a term that is much more easily to be understood by practitioners. Furthermore, the word "interaction" is pertinent to how exactly knowledge can be mobilised, that is, via interactions between different people involved in the collective practice who have shared cognitive overlaps. Specific boundary-spanning mechanisms in each of the three categories were discovered from the empirical study in Chapter 4. For example,

- Boundary objects used in agri-food practice: Websites, PowerPoint presentations, Information technology infrastructure, Databases, Guidelines, Newsletters, Education packages, Sketches and diagrams, Documentations
- Boundary spanners used in agri-food practice: Knowledge brokers who have hybrid professional roles, Knowledge workers who have a deep background in education and experience in an organisation , Top managers, mid-level managers and junior-level managers in an organisation, Internal facilitators (i.e. knowledge mobilisation associates), External facilitators (i.e. management consultants)
- Boundary interactions: Face-to-face meetings, Video conferences, Fieldwork, Online/In site forums, Focus groups, Learning sessions, Training programme, stakeholder engagement events

Both SLR in Chapter 2 and qualitative study in Chapter 4 have contributed to answer RQ2.

The third research question (i.e. RQ3) asks about the impact from boundary-spanning mechanisms on agri-food supply chain lean performance. In the SLR (Chapter 2), no study was found to establish quantified relationships between them even though some mentioned that the relationships should be studied, hence the KMob conceptual framework includes an arrow from the "Boundary-spanning mechanism" block to "Supply chain lean performance" but without

substantiation. During the quantitative phase of the empirical study of this PhD project, the author was able to collect over 300 survey questionnaires and analysed them using Structural Equation Modelling (SEM) method, to have established quantifiable impact from the "Boundary-spanning mechanisms" to "Supply chain lean perform". Via the empirical study in Chapter 5, hypotheses were tested to confirm positive impact from the all three categories of boundary-spanning mechanism to five different lean performance KPIs. The answers to RQ3 is considered key findings from this study which filled in knowledge gaps in literature.

7.3 Contributions

The key contributions from this study can be classified into two categories: theoretical contribution (i.e. contribution to new knowledge) and practical contribution (i.e. implications for management practice). Figure 7.2 summaries the key contributions and implications.

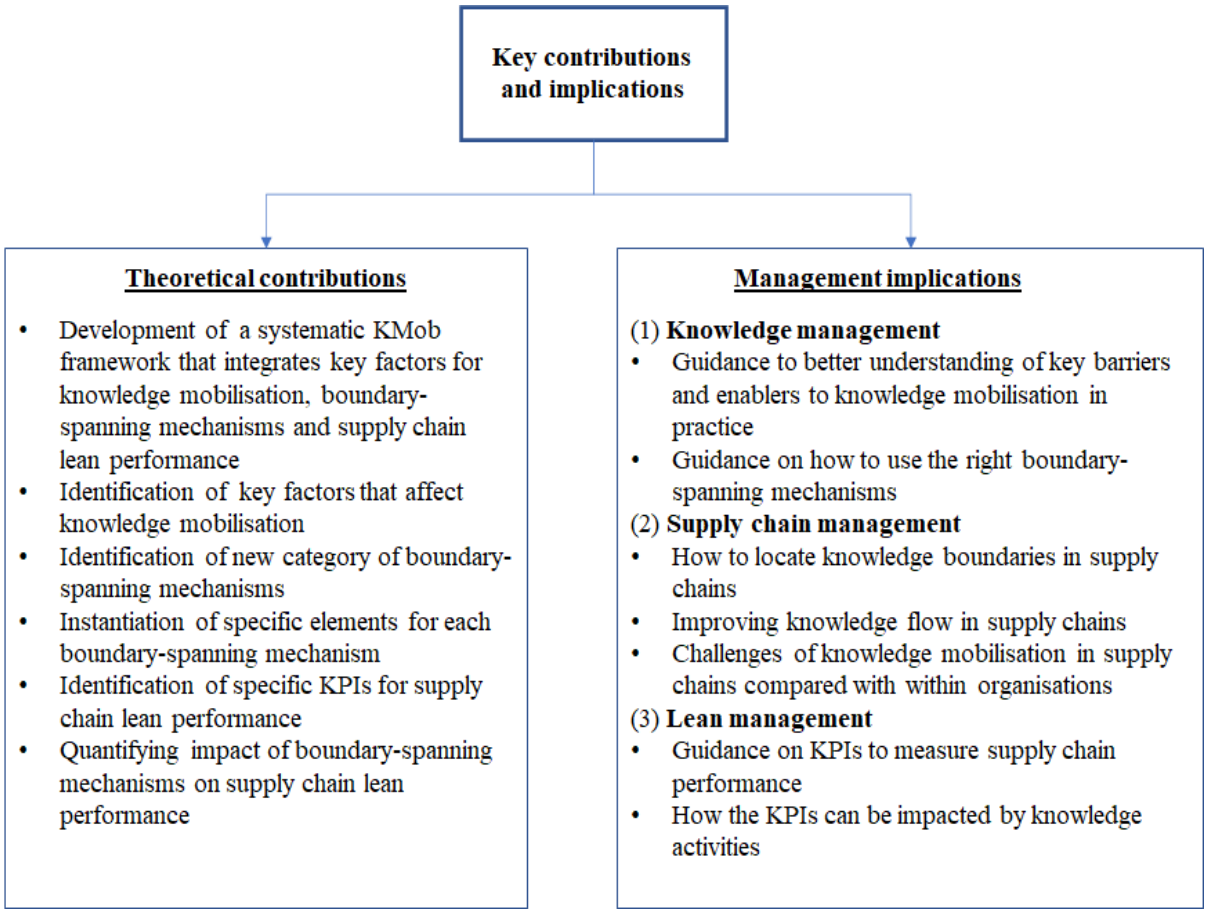


Figure 7.2: Summary of key research contributions and implications

7.3.1 Theoretical contributions

This study has discovered the integration of multiple knowledge mobilisation components with empirical evidence (i.e. key factors – barriers to create knowledge boundaries and enablers to help remove knowledge boundaries, boundary-spanning mechanisms, and supply chain lean performance). This study focused on empirical evidence of an innovative, systematic knowledge mobilisation framework dedicated to knowledge mobilisation crossing knowledge boundaries in agri-food supply chains. The findings of this study have made a number of contributions to new knowledge as highlighted in Figure 7.2.

Firstly, the KMob conceptual framework is the first systematic framework that establishes the links knowledge boundaries erected from key barriers, boundary-spanning mechanisms to remove knowledge barriers, and lean performance in agri-food supply chains. The study further collected empirical data from seven countries across Europe (UK, France, Italy, Poland and Spain) and South America (Chie and Argentia) to extend and validate the conceptual framework. After both qualitative and quantitative phases of empirical study, the validated empirical KMob framework not only expanded with extensive elements for each of the building blocks, but also establishes clear, quantified relationships between the building blocks. This is novel because no existing work has ever integrated all three building blocks. Previous work only tackled the three building blocks in an isolated matter (Boshkoska, Liu & Chen, 2018; Chen et al, 2018;), with much fewer elements for each building block, in more traditional, stable supply chains. But this research has created a much more comprehensive framework (i.e with new components, elements, and relationships), focusing on the most challenging knowledge mobilisation issue (i.e. crossing knowledge boundaries), in a supply chain that has much more uncertainty and risks (i.e. agri-food supply chains). This is a significant contribution to new knowledge.

Secondly, this study have identified a collection of key factors to affect knowledge mobilisation

in agri-food value chains, and have ranked the factors in order of importance. Based on the systematic literature review, in total eleven key factors were identified which are included in the KMob conceptual framework. According to the frequency of the factors appearing in literature in descending order, they are collaboration, supply network structure, power, technology, trust, training and education, commitment, time, cost, and continuous improvement (Amentae, 2018; Kebebe, 2018). The SLR also analysed how these factors change over time over 15 years (from 2006 to 2021) to see the trends. Over the time period, collaboration and supply network structure have remained as top two most important factors. The importance of power has decreased over time. Factor of training and education has increased overall. Technology has also shown an overall increase or maintaining high importance. Three of factors, however, have disappeared over time: commitment, time and cost. Subsequently, in the empirical study, only the eight remaining factors are investigated. The findings from empirical study generally confirmed that from SLR, hence presents good consistency between the conceptual and empirical study. Based on this, it is fairly confident to believe that properly addressing the eight kay factors are crucial to the success of knowledge mobilisation in agri-food supply chains. The eight remaining factors are: collaboration, supply network structure, power, technology, training and education, trust, culture, and continuous improvement.

Thirdly, this study identified a new category of boundary-spanning mechanisms, namely boundary interactions. This new category highlights the importance of interactions between different partners/stakeholders at the boundary, such as on the boundary between two different stages of the supply chain. Knowledge can only be mobilised from one stage of the supply chain to another when partners come together to interact with each other (Boshkoska, Liu & Chen, 2018). In literature, “boundary interactions” was not identified as a boundary-spanning mechanism, hence it is not included in the KMob conceptual framework. The category was discovered during the qualitative phase of the empirical study, which further defined eight

specific mechanisms to cross knowledge boundaries via interactions, including face-to-face meetings, video conferences, fieldwork, online/onsite forums, focus groups, learning sessions, training programme, stakeholder engagement events. The new category of "boundary interactions" and its eight specific mechanisms were added to the empirical KMob framework.

Fourthly, this study enriched the meaning of two exiting categories of boundary-spanning mechanisms: boundary objects and boundary spanners. The terms of two categories have been defined in literature based on original work done in the product development and manufacturing context, however there is very little instantiation of specific boundary-spanning solutions in each category (Chen et al, 2018). This study extended the literature by extensively instantiating the content of two categories based on empirical data collected from seven countries across Europe and South America in agri-food supply chains. Nine specific mechanisms were identified with significant usage to enrich "boundary objects" and five to "boundary spanners".

Fifthly, this study identified important KPIs for agri-food supply chain lean performance. Lean management approach mainly originated from lean manufacturing and pioneered by Japanese scholars and practitioners in automotive industry, however because of the differences between agri-food supply chains and automotive manufacturing processes, the lean performance measures in literature have to be analysed, adapted or redefined (Garcia-Buendia, Moyano-Fuentes & Maqueira-Marín, 2021). Based on the SLR, this study adapted five specific KPIs and included them in the conceptual KMob framework, including inventory reduction, quality assurance, lead-time reduction, on-time delivery and smooth operations flow. These five KPIs were further included in the SEM analysis during the quantitative phase of the empirical study.

Finally, this study established quantifiable relationships between boundary-spanning mechanisms and lean supply chain performance. Through the quantitative phase of the empirical study, this PhD project was able to quantify the impact of three categories of

boundary-spanning mechanisms (i.e. boundary objects, boundary spanners and boundary interactions) on agri-food supply chain lean performance (using the five KPIs discussed in Point 5 above). The quantified relationships were based on data collected from over 300 survey questionnaires which were analysed using Structural Equation Modelling (SEM) method. To the author's best knowledge, this is the first time the relationships between boundary-spanning mechanisms and lean KPIs were empirically tested and supported for agri-food supply chains.

7.3.2 Management implications

Besides the contributions to theory, this research also has a number of contributions to business management practices. The practical contributions can be classified in three aspects, implications for knowledge management, supply chain management and lean management.

First, to knowledge management, this study provides guidance for better understanding of key factors affecting knowledge mobilisation, including both barriers to create knowledge boundaries and enablers to help remove knowledge boundaries. Among the eleven key factors included in the conceptual KMob framework, eight of them were further included in the empirical framework. The evolution from the conceptual framework to empirical framework demonstrates how key factors changed over time and how they were perceived by literature and practitioners. Furthermore, this study identified four categories of boundary-spanning mechanisms (i.e. boundary objects, boundary spanners, boundary practice and boundary discourse) at the conceptual stage and defined three categories in the empirical stage (i.e. boundary objects, boundary spanners and boundary interactions). The findings provides guidance to knowledge management officers on what specific boundary-spanning solutions in each category can be used to overcome what type of knowledge boundaries created by what potential barriers. The links established from knowledge barriers through knowledge boundaries to boundary-spanning mechanisms provides a systematic approach to knowledge management, especially in the context of knowledge mobilisation crossing boundaries.

Second, to supply chain management, this study provides guidance on how to identify and locate possible boundaries in agri-food supply chains that could create difficulties for knowledge mobilisation. For example, supply chain managers will be more conscious and aware of various types of boundaries along the supply chain, such as different stages of a supply chain, technologies, organisational, cultural and geographical boundaries can all erect barriers for knowledge mobilisation if relevant issues are not properly addressed, hence could negatively impact on supply chain performance. One typical example would be that is knowledge mobilisation is not effective along an agri-food supply chain, the issues related to food quality and shelf-life cannot be adequately addressed. The whole supply chain has to collaborate and tackle the knowledge boundaries, to enable sooth flow of knowledge from one stage of the supply chains to the next. This study has also highlighted the challenges facing supply chain management in terms of moving knowledge around in comparison with within-organisation activities.

This chapter 5 focuses on the discussion and analysis of KMob with its communication mechanisms that are needed to facilitate lean supply chains success. In reality, many organisations tend to develop a KMob program without consideration of its process (tasks and activities), however, this study strongly supports that organisations have a trend of successful KMob via development of important boundary spanning mechanisms. The results imply that mechanisms of boundary spanners, boundary objects and boundary interactions take shape an operational view of theory of KMob. Besides, these also imply the importance of tools or technologies that help to take shape a foundation for the KMob framework. Together, results suggest that the theory of KMob offer abundant resource of developing empirically on the basis of researches as well as tools or technologies may offer a criterion for management KMob in or across organisations.

In many situations, setting up a knowledge-based organisation with little consequence, because

of the lack of technologies or tools. Knowledge artefacts is collection as well as link of databases with high quality information, research results, and lots of relevant resources (Mariano and Awazu, 2016). For many managers, on-going records of KMob process can be instruments of processes evaluation. Such records become more efficient in providing a broader view on stakeholder contributions. Therefore, managers should note the fact that for the formation of ideas and the adoption and implementation of new ideas in KMob, they have to use the tools of communication through the internet, joint meetings and conferences, etc. The application of communication mechanisms in the organisations is considered as a competitive advantage to improve lean performance of the supply chain (Mason and Leek, 2008).

Importantly, the organisation should build and maintain the KMob team. The facts show that the knowledge privacy had stopped senior personnel from delivering their knowledge down to next standard. At the same time, some organisations don't have time to waste on studying because studying is lost work as well as therefore invalid. When teams listen, they can see similar attitudes in some senior leaders and middle directors (Bennet et al., 2007). All in all, the KMob team can provide knowledge on how to improve operations and set up a cooperative and studying circumstances.

Last, but not least, this study has implications for lean management practice. The five lean KPIs identified and validated in this study can be used by agri-food managers to focus on. Inventory reduction along supply chain makes great sense as the accumulative inventory along a supply chain could hold significant costs, in the meantime, excessive inventory in agri-food supply chains is a massive risk because agricultural products are perishable and usually have short shelf-life. When agricultural materials and products are held in inventory for too long, it could create heavy cost when products go off, unsafe to sell or become below quality standards. This is a very important issue for lean managers in practice. This study has further provided guidance to lean managers to follow the quantified relationships between knowledge mobilisation

(specifically boundary-spanning mechanisms) and lean performance KPIs. These quantified relationships can help lean managers to choose the right KPIs to implement according to how what boundary-spanning mechanisms are available in their practice.

It needs to be mentioned that this study would recommend business management take an integrative management approach in practices, that is, to look at knowledge management, supply chain management and lean management together viewing the whole supply chain as one synchronised system, rather than seeing them as three isolated components.

7.4 Limitations of the study

Although both empirical and conceptual findings of this study are promising and valuable, a number of limitations have been recognised which may be useful for future research. How and why it is important to extend in future research to overcome these limitation will be discussed in the nest section. The limitations of this study are:

This study identified eleven key factors potentially affecting knowledge mobilisation in the conceptual stage and validated eight of them in the empirical study. During both stages, the ordering of the key factors is based on frequency of these factors appeared in literature or mentioned via interviews. As the project was severely affected by the covid-19 pandemic, further plan to rank the factors using more scientific methods such as AHP and evaluation using field visits was not able to go ahead. This provides opportunities for future research.

Four categories of boundary-spanning mechanisms were elicited from SLR and three were identified in empirical study. Even though the identification of a completely new category (i.e. boundary interactions) and population of in total 22 specific mechanisms for the three categories via analysis of empirical data (9 boundary objects, 5 boundary spanners and 8 boundary interactions), there may be more categories and specific boundary-spanning mechanisms yet to be discovered in agri-food supply chains.

This study collected data from Europe and South America, which actually have a lot of shared

value and culture in agricultural supply chains. The study originally also planned to collect data from China, Asia, which could have provided a new dimension in terms of knowledge mobilisation. Because of covid-19 break-out and country lockdown, it was not possible to conduct field visits and interview farmers in China. This brings another unexpected limitation to the study.

This study is strictly within the agri-food supply chain context. The empirical data were collected from crop-based agricultural food chains only, hence it is not clear whether the findings can be directly applied to other types of food chains such as dairy products and meat products. The generalisation of the findings to wider supply chain contexts needs further testing. The above limitations can be converted into opportunities for further research to be explained in the next section.

Though the chapter 5 shows clear evidence on the effect of KMob of lean supply chain performance, there are several limitations as follow. Firstly, the research suffers from latent response bias using single informant data. The practice is classic of survey study. Multiple informants may be the best way of getting the most exact data, but such a method would restrict the number of problems which may be proposed and also limited useful gathered information (Groves et al., 2011; Fowler, 2013). In general, possible over illustrating or under illustrating of certain phenomenon could happen because of respondents' job satisfaction and personal or role features (Gold, Malhotra and Segars, 2001). Second, in order to generate findings that are representative of the whole population, the researcher needs to ensure the sample is representative and try to ensure a good response rate. Thus, additional observations are needed to improve and enhance the analysis and to provide more conclusive results, particularly to assess the measures used in validity and reliability tests(Saunders, Lewis and Thornhill, 2019). Third, the proposed research model as well as study hypothesis were according to previous literatures and perceived quality of KMob and lean performance in the supply chain procedures,

the model re-estimation was not executed. Therefore, the research model needs further confirmation. Besides, for specimen for the research was only drawn of agri-food supply chains. However, different industries may prefer a specific KMob model in the worldwide marketplace. In this regard, it is necessary to perform empirical researches from a wider scope of industries to offer further evidence as well as acquire more generalizable consequences.

7.5 Recommendations for further research

During the PhD project process, some ideas and notes were observed as interesting but were not directly related to the three research questions and objectives of the thesis, or because of time and resource constraints thus are not fully investigate, hence deserve more attention in future work. They are:

It would be worth considering the generation of the findings from this study. In order to have sufficient confidence in generalise findings to other supply chain context, further research should significantly increase the sample size for both SLR and empirical study. In generalising the KMob framework, the building blocks may need to be decomposed into smaller segments and elements, and future work should develop more hypotheses at multiple levels to test the relationships between the segments and elements. To quantify the relationships between the building block of key factors affecting knowledge mobilisation and that of boundary-spanning mechanism would be also interesting.

Testing and exploring the KMob framework developed in this study in other cultural, social and geographic settings, including Asia, Africa, North America and other western countries, would be valuable in providing evidence concerning the robustness of the framework fitting into internationalisation of supply chains. This can be done using the same interview template by conducting semi-structured interviews with agri-food supply chains stakeholders in the above identified geographical regions.

Proving scientific methods to rank the key factors affecting knowledge mobilisation and lean

performance KPIs in the KMob framework would be an interesting direction for future research. There are some widely used decisions methods such as Analytic Hierarchy Process (AHP) that can be used to rank and prioritise factors, in order to provide more precise recommendations to management practice when resources are limited and not all factors can give equal attention. It would also be advisable to investigate the inter-relationships among different key factors affecting knowledge mobilisation and inter-relationships among different supply chain lean KPIs. For example, using TISM (Total Interpretive Structural Modelling) can establish relationships among different factors and find out which factors or KPIs may influence or drive other factors most and in what pattern (Zhao et al, 2021). By finding out the factors or KPIs that have the most driving power or are least dependable, it would be very useful for business managers to make the right decisions in how to select which factors or KPIs to focus on if not all factors or KPIs can be invested at the same time.

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Appendices

Appendix A: Consent form

CONSENT FORM

Title of research project: A Knowledge Mobilisation Framework for Lean Supply Chains in Agri-food Industry

Name of researcher: Huilan Chen

Please initial box

1. I confirm that I have read the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. ☐

3. I agree to take part in the above study. ☐

4. I agree to the interview being audio recorded. ☐

5. I agree to the use of anonymised quotes in publications. ☐

Name of Participant Date Signature

Researcher Date Signature

Appendix B: Interview template

Semi-structured Interview Questions

On commencing the interview:

- Explain the purpose of the interview,
- Express the importance of their views and experience,
- Give an assurance of confidentiality,
- Ask the interviewee's permission to record the interview if appropriate.

Part 1: This part asks questions about your general background

Q1 What is your organisation's role in the agricultural production value chain?

☐ Farm ☐ Food processor ☐ Distributor ☐ Retailer ☐ Interest Group

☐ Education/Research Institute ☐ Consultancy/Advisory Agency

☐ Other (please specify here)

Q2 What is the size of your company?

☐ Micro (fewer than 10 employees) ☐ Small (10 to 50 employees) ☐ Medium (51 to 250 employees) ☐ large (over 250 employees)

Q3 What is the geographic location of your organisation?

☐ Europe ☐ South America ☐ Asia ☐ North America ☐ Oceania

Q4 What is the main functional area that you work in the organisation?

☐ Production ☐ Sales and marketing ☐ Procurement/buying ☐ Finance and accounting ☐ Logistics ☐ Research and development

☐ Other (please specify here)

Q5 What is your role/position in your organisation?

☐ Farmer ☐ Specialist ☐ Administrator ☐ Supervisor ☐ Senior manager ☐ Director/Executive ☐ Scientist ☐ Academic ☐ Other (please specify here)

Q6 How many years of work experience in relevant areas have you had?

☐ Less than 5 years ☐ 6-10 years ☐ 11-15 years ☐ 16-20 years ☐ More than 20 years

Part 2: In this part we are interested in identifying key factors impacting the successful implementation of knowledge sharing

Q7 What are critical success factors which helps to increase effectiveness of sharing and transfer knowledge?

Following Questions

Q8 Please tell me which of them is most important?

Q9 What are the absolutely necessary factors required to transfer knowledge?

Q10 Please tell me the most important factor among them?

Part 3: In this part we are interested in knowing who can frame and translate knowledge from one domain to another. We use the term "boundary spanners", meaning human agents who use language and their cognitive power to translate knowledge across boundaries.

Q11 Based on the membership status of the spanners, what are the different types of boundary spanners used in your organisation?

Q12 What other boundary spanners do you think can create collaborative relationships between members and develop more inclusive economies, societies and institutions of governance?

- More different types of boundary spanners are (please provide as many as you can think of):
- Please explain why they are not used yet:

Part 4: In this part we are interested in knowing how you store and share knowledge which is important to running your organisation. We use the term "boundary objects", meaning objects or items in which knowledge can be stored or embedded and so shared.

Q13 What are the main types of boundary objects used in your organisation?

Q14 What other boundary objects do you think can or should be used in your organisation, and why are they not being used?

- Suggestions on boundary objects (please provide as many as you can think of):
- Please explain why they are not used yet:

Part 5: In this part we are interested in identifying boundary interactions you use for knowledge sharing.

Q15 What boundary interactions are used in your organisation to share knowledge?

Q16 What other boundary interactions do you think your organisation could benefit from but have no access to. Please explain the barriers to not having access to the boundary interactions.

- Other boundary interactions are (please provide as many as you can think of):
- Please explain why these are not available to your organisation:

End of interview

Thanking participant for taking part in the study and for their time and assistance. Assure participant that all information obtained is confidential. If participant wishes to receive the findings of study. Ask for their business card to fill in the information. Assure them that these details will be stored separately from the interview responses in order to maintain confidentiality.

Appendix C: Survey questionnaire

The impact of knowledge mobilisation process on lean supply chain performance

1. Highest degree I possess

○Doctorate

○Master

○Bachelor

○High school / Technical training diploma

2. My education discipline is

○Engineering

○Business/management

○Science

○Other disciplines

3. My job rank is

○Senior manager

○Middle manager

○Operational manager

○Organizational expert

4. Length of service with my current employer is

○1~5 years

○6~10 years

○11~15 years

○16~20 years

○Over 20 years

5. My organization responses to employees ideas and documents them for further development

1 ○1 ○2 ○3 ○4 ○5 5

6. My organization has mechanisms in place to absorb and transfer knowledge from employees, customers, and business partners into the organization

1 ○1 ○2 ○3 ○4 ○5 5

7. My organization has mechanisms for converting knowledge into action plans and the design of new products and services

1 ○1 ○2 ○3 ○4 ○5 5

8. My organization has policies in place to allow employees to present new ideas and knowledge without fear and ridicule.

1 ○1 ○2 ○3 ○4 ○5 5

9. My organization has knowledge in the form that is readily accessible to employees who need it (intranet, internet, etc.)

1 ○1 ○2 ○3 ○4 ○5 5

10. My organization sends out timely reports with appropriate information to employees, customers, and other relevant organizations

1 ○1 ○2 ○3 ○4 ○5 5

11. My organization has libraries, resource center and other forums to display and disseminate knowledge

1 ○1 ○2 ○3 ○4 ○5 5

12. My organization has regular symposiums, lectures, conferences, and training sessions to share knowledge

1 ○1 ○2 ○3 ○4 ○5 5

13. My organization has mechanisms for integrating knowledge from different sources such as employees, customers, business partners, and competitors

1 ○1 ○2 ○3 ○4 ○5 5

14. My organization encourages and has processes for the exchange of ideas and knowledge between individuals and groups

1 ○1 ○2 ○3 ○4 ○5 5

15. My organization rewards employees for new ideas and knowledge

1 ○1 ○2 ○3 ○4 ○5 5

16. My organization has mechanisms for creating new knowledge from existing knowledge and uses lessons learnt and best practices from projects to improve successive projects

1 ○1 ○2 ○3 ○4 ○5 5

17. My organization has a policy to review knowledge on a regular basis.

1 ○1 ○2 ○3 ○4 ○5 5

18. My organization has the responsibility to keep knowledge current and up to date

1 ○1 ○2 ○3 ○4 ○5 5

19. My organization has mechanisms for retaining different sources and types of knowledge

1 ○1 ○2 ○3 ○4 ○5 5

20. My organization gives feedback to employees on their ideas and knowledge in order to hold down new knowledge

1 ○1 ○2 ○3 ○4 ○5 5

21. My organization has different methods for employees to further develop their knowledge and apply them to new situations

1 ○1 ○2 ○3 ○4 ○5 5

22. My organization has mechanisms to protect knowledge from inappropriate or illegal use inside and outside of the organization

1 ○1 ○2 ○3 ○4 ○5 5

23. My organization applies knowledge to critical competitive needs and quickly links sources of knowledge in problem solving

1 ○1 ○2 ○3 ○4 ○5 5

24. My organization has methods to analyse and critical evaluate knowledge to generate new patterns and knowledge for future use

1 ○1 ○2 ○3 ○4 ○5 5

25. My organization performs very well in demand and supply planning and management activities

1 ○1 ○2 ○3 ○4 ○5 5

26. My organization performs very well in planning activities for the entire supply chain

1 ○1 ○2 ○3 ○4 ○5 5

27. My organization performs very well in gathering customer requirements, collecting information on available resources, and balancing requirements and resources to determine planned capabilities and resource gaps

1 ○1 ○2 ○3 ○4 ○5 5

28. My organization performs very well in the ordering and receipt of goods from suppliers

1 ○1 ○2 ○3 ○4 ○5 5

29. My organization performs very well in managing work-in-process and finished goods inventory

1 ○1 ○2 ○3 ○4 ○5 5

30. My organization performs very well in identifying what the customer wants for delivery when he needs it

1 ○1 ○2 ○3 ○4 ○5 5

31. My organization performs very well in managing production equipment and facilities

1 ○1 ○2 ○3 ○4 ○5 5

32. My organization performs very well in executing total quality control activities

1 ○1 ○2 ○3 ○4 ○5 5

33. My organization performs very well in shelf life management

1 ○1 ○2 ○3 ○4 ○5 5

34. My organization performs very well in customer order management activities

1 ○1 ○2 ○3 ○4 ○5 5

35. My organization performs very well in warehouse management activities from receiving and picking products to load and ship products

1 ○1 ○2 ○3 ○4 ○5 5

36. My organization performs very well in routing shipments, selecting carriers, product transportation, as well as product reception and verification at the customer site

1 ○1 ○2 ○3 ○4 ○5 5

37. My organization performs very well in tool and production design

1 ○1 ○2 ○3 ○4 ○5 5

38. My organization performs very well in executing value engineering and value analysis activities

1 ○1 ○2 ○3 ○4 ○5 5

39. My organization performs very well in improving packaging to keep goods fresher for longer

1 ○1 ○2 ○3 ○4 ○5 5

40. My organization performs very well in identifying and selecting supply sources as well as managing supplier networks and supplier agreements

1 ○1 ○2 ○3 ○4 ○5 5

41. My organization performs very well in scheduling production activities and managing production performance as well as in-process products

1 ○1 ○2 ○3 ○4 ○5 5

42. My organization performs very well in executing just in time production or manufacturing activities

1 ○1 ○2 ○3 ○4 ○5 5

43. My organization utilizes databases, repositories and information technology applications to store knowledge for easy access by all employees

1 ○1 ○2 ○3 ○4 ○5 5

44. My organization utilizes various written devices such as newsletter, manuals to store the knowledge they capture from employees

1 ○1 ○2 ○3 ○4 ○5 5

45. My organization has different publications to display the captured knowledge

1 ○1 ○2 ○3 ○4 ○5 5

46. My organization has mechanisms to patent and copyright new knowledge

1 ○1 ○2 ○3 ○4 ○5 5