AUTOMATED KNOWLEDGE ACQUISITION FRAMEWORK FOR SUPPLY CHAIN MANAGEMENT BASED ON INTEGRATING CASE-BASED REASONING AND INTELLIGENT AGENT

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THESIS SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

FACULTY OF INFORMATION SCIENCE AND TECHNOLOGY
UNIVERSITI KEBANGSAAN MALAYSIA
BANGI

2018

DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

15 February 2018

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P52686

ACKNOWLEDGEMENTS

Praise to Allah the almighty for keeping me patient and focused on the goals I set out to achieve and allowing me to remain healthy throughout my studies! Although the path has not been smooth, it's been a wonderful journey! There have been peaks, vallies and even holes. I've faced countless happy moments and also problems, which I am unable to put into words. I've learned and grown from all of these experiences, both positive and negative. And for all of these, I am deeply grateful. May peace and blessing of Allah be upon His beloved Prophet Muhammad (SAW), his family and his companions.

It is my pleasure to thank from the heart, a number of people who helped me and contributed to the completion of my thesis. Without their support and encouragement, I could never have done any of my work.

To my supervisor, Prof.Dr Juhana Salim , for her great supervision, guidance and support throughout the development of this thesis, I appreciate all of her special ways. Her direction and advice provided me "the best platform" to undertake this thesis and allowed me to open my mind to challenge myself. I thank her for dedicating so much of her time to answering my questions and proposing better ideas for thesis writing.

I wish to voice my appreciation to my family and friends for their continued support, encouragement and understanding throughout my doctoral studies. Patience, sacrifice and love, intangible and invaluable assets provided by my parents, brothers and sisters kept me going during challenging time of my life. I shall never forget the support of my friends Saleh Al-qatan, Mohannad Al-shbail, Ala' Almuiet, Mohammad Aloun and others for being there to encourage me throughout the doctoral studies.

Further acknowledgements go to my fellow colleagues at the Faculty of Information Science and Technology, for their warmth and comfort during my pleasant stay at Universiti Kebangsaan Malaysia.

ABSTRACT

Knowledge Acquisition (KA) refers to process that is used to acquire the knowledge from inside and outside the firms. Organizations and industrial companies realized the need for knowledge to be acquired in order to solve many problems associated with the manufacturing process, such as slow process techniques, high material consumption, and poor machine quality. KA has been examined from the theoretical perspective to indicate its relationship and impact on Supply Chain Management (SCM). Very few research have studied KA automation to simplify KA. Presently, there has been no framework that addresses the automation of KA in SCM in terms of knowledge acquiring, reusing and storing. Various frameworks in SCM have been proposed by researchers based on Case Based Reasoning (CBR) and Intelligent Agent (IA) perspective. This study developed an Automated KA Framework (AKAF) as a guide to providing KA benefits in the SCM through the understanding of the knowledge types, the functions of the supply chain, and the integration of artificial intelligence approach, which is CBR and IA. This study considers three underpinning theories to motivate the premise that supply chain knowledge management and integrating CBR-IA will improve the acquisition, storage and reuse of knowledge and they are, knowledge-based theory, resource-based theory and Nonaka's model. The study aims to achieve four research objectives based on five research questions. Data was gathered in a span of six months (January-June 2015), using semi-structured interviews conducted with senior officials, executive managers, shop-floor employees and customers (supply chain partners) in order to design a Framework for the Automated Knowledge Acquisition in Supply Chain Management (FAKASCM). Data was analyzed using descriptive and thematic analysis. FKASCM was designed based on three parts: the first part is the supply chain knowledge that exist in SCM, and among the supply chain partners. The second part is the knowledge modelling based on supply chain functions. The last part integrates CBR-IA. The Automated Knowledge Acquisition in SCM Prototype (AKASCMP) was developed using prototyping life cycle method to validate the proposed framework. The data for evaluation of AKASCMP was collected from November 2016 to April 2017 via a structured questionnaire survey which yielded 30 usable questionnaires and interview with the 6 experts to validate the framework. The evaluation had its basis on the usability and experiments, with the former done through experts' interviews and the latter done based on similarity function to evaluate the integration of CBR and IA. The results of this study showed that the supply chain knowledge could be acquired, stored and reused by the acceptability of the AKASCMP. It was found that the experimental result of integrating CBR and IA is effective in terms of acquisition, storing and reusing of the supply chain knowledge.

ABSTRAK

Perolehan Pengetahuan (PP) merujuk kepada proses yang digunakan untuk memperoleh pengetahuan dari dalam dan luar firma. Organisasi dan syarikat perindustrian menyedari keperluan untuk memperolehi pengetahuan untuk menyelesaikan banyak masalah yang berkaitan dengan proses pembuatan, seperti teknik proses yang lambat, penggunaan bahan yang tinggi, dan kualiti mesin yang kurang baik. PP telah dikaji dari sudut perspektif teoritis yang menunjukkan hubungan dan impaknya kepada Pengurusan Rantaian Pembekalan (PRP). Terdapat beberapa kajian sahaja yang telah mengkaji PP secara automatik dalam Pengurusan Rantaian Bekalan (PRB) bagi memudahkan proses PP. Pada masa Kini, tidak ada rangka kerja yang dapat menangani PP dalam rangkaian bekalan dari segi peolehan, penggunaan semula dan penyimpanan. Pelbagai rangka kerja di PRP telah dicadangkan oleh para penyelidik berdasarkan perspektif Penaakulan Berdasarkan Kes (PBK) dan perspektif Ejen Pintar (EP). Kajian ini mereka bentuk rangka kerja PP Automatik (KPPA) sebagai panduan untuk menyediakan manfaat PP di PRP melalui pemahaman tentang jenis pengetahuan, fungsi rantaian bekalan, dan integrasi pendekatan kecerdasan buatan, iaitu PBK dan EP. Kajian ini mengemukakan tiga teori asas untuk memotivasikan premis bahawa pengintegrasian PBK dan PEP dalam pengurusan pengetahuan rantaian bekalan mampu untuk meningkatkan perolehan, penyimpanan dan penggunaan semula pengetahuan berdasarkan teori berasaskan pengetahuan, teori berasaskan sumber dan model Nonaka. Kajian ini bertujuan untuk mencapai empat objektif berdasarkan lima soalan kajian. Data dikumpulkan dalam tempoh enam bulan (Januari-Jun 2015), menggunakan temubual separa berstruktur yang dijalankan dengan rakan kongsi rantaian bekalan seperti pegawai kanan, pengurus eksekutif, pekerja kedai dan pelanggan untuk membangunkan rangka kerja konseptual Perolehan Pengetahuan Secara Automatik Dalam Pengurusan Rantaian Bekalan (PPSAPRB). Data telah dianalisis menggunakan analisis deskriptif dan tematik. PPSAPRB direkabentuk berdasarkan tiga bahagian: pertama, pengetahuan rangkaian bekalan yang ada di PRP dan antara rakan rantaian bekalan. Bahagian kedua adalah pemodelan pengetahuan berdasarkan fungsi rantaian bekalan dan bahagian terakhir mengintegrasikan PBK dan EP. Prototaip PP Automatik dalam Pengurusan Rantaian Pembekalan (PPPAPRP) dibangunkan menggunakan kaedah kitaran hayat prototaip bagi mengesahkan kerangka yang direkabentuk. Data untuk menilai PPPAPRP dikumpulkan dalam tempoh November 2016 hingga April 2017 melalui kaji selidik soal selidik berstruktur yang menghasilkan 30 borang soal selidik yang boleh digunakan dan temubual dengan 6 pakar untuk mengesahkan rangka kerja. Penilaian kerangka dibuat berdasarkan kepada kebolehgunaan dan eksperimen yang dilakukan melalui temubual pakar dan fungsi kesamaan untuk menilai integrasi PBK dan EP. Hasil kajian ini menunjukkan bahawa pengetahuan rantaian bekalan dapat diperoleh, disimpan dan digunakan semula oleh pengguna PPPAPRP. Hasil eksperimen yang mengintegrasikan PBK dan EP menunjukkan perolehan, penyimpanan dan penggunaan semula pengetahuan rangkaian bekalan didapati berkesan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

KA	Knowledge Acquisition
KM	Knowledge Management
KMS	Knowledge Management System
SC	Supply Chain
SCM	Supply Chain Management
AI	Artificial Intelligence
CBR	Case Based Reasoning
IA	Intelligent Agent

CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

In the current era of knowledge economy, the value and importance of knowledge is evident in its increasing recognition as a deciding variable of business success. Knowledge has become a crucial element for economic growth, principally in project work and in social development. During the past decade research on knowledge has emerged as a new direction in the literature of many research domains such as management and information system. Knowledge is becoming the most important asset for organisational success among other assets such as capital, materials, machineries, and properties. Success in business is believed to be dependent more and more on organisation's knowledge.

Ge guo and Li (2008) asserted that the real decisive factor in successful production (of goods and services) is not capital or labor, but knowledge. Virtually all economic enterprises today are increasingly aware that a maximal utilization of knowledge sources can create significant value for their projects.

Organizations are establishing dedicated departments of Knowledge Management (KM) as one of the most important ways to achieve a competitive advantage over their peers. Such competitive advantage can be derived from a multitude of knowledge applications such as: the use of intangible resources, and the ethical use of sources to cover a wide variety of information, communication and even patents , all of which incur such beneficial repercussions as: enhanced reputation of organization, enhanced user experience, and improved organizational culture (Hall and Andriani 1998). The significance of Knowledge Management (KM) is rooted in the twofold advantage it brings

to an organization both externally, in attaining competitive market advantage, and internally, in enabling effective work processes through the sharing and reuse of knowledge (Abdullah et al. 2005). Consequently, KM is garnering increasing attention from organizations including Supply Chain Management (SCM) (Kahn et al. 2006; Craighead et al. 2009; Linderman et al. 2010; Grawe et al. 2011; Schoenherr et al. 2014).

The organizations' need to leverage their supply chain strengths is evident if they are desirous of remaining competitive (Kahn et al. 2006; Schoenherr et al. 2014). This has resulted in the assumption of supply chains going against others of its kind. In this context, there are major aspects of competitiveness that are covered with the knowledge of logistics and supply chain partners, laying emphasis on the importance of the knowledge management within supply chain as a study area (Craighead et al. 2009). Knowledge management is generally important for management's decision making process when it comes to logistics and supply chain management because knowledge is naturally crucial for solving problems and guaranteeing the development of strategy (Kahn et al. 2006). However, notwithstanding the studies dedicated to the creation and management of knowledge (Fugate et al. 2009; Anand et al. 2010), the field is still in its infancy (Linderman et al. 2010), particularly within the logistics and supply chain domain (Grawe et al. 2011). Supply chain in this case refers to the use of knowledge resources acquired from supply chain partners for gaining economic advantages (Schoenherr et al. 2014).

SCM and KM are concepts that have emerged as distinct philosophies in the last decade with a tremendous potential to revolutionize the business world. Both are evolving and with further research and practice are expanding their boundaries (Maqsood et al. 2003). There are many practitioners, academics and authors who have contributed significantly to SCM and KM independently which produced seminal works that have shaped organizations and their people practices (Wadhwa and Saxena 2005).

For instance, Lopez and Eldridge (2010) developed a working prototype to promote creation and control in a knowledge supply chain with the objective of diffusing the best practices among supply chain practitioners; Done (2011) developed a framework for supply chain knowledge management along with literature-based definitions of

supply chain knowledge transfer, competence and maturity constructs, imported these perspectives into supply chain domains, with efforts to maintain conceptual consistency. Capó-Vicedo et al. (2011) proposed a social network-based model to improve knowledge management in multi-level supply chains formed by small and medium-sized enterprises (SMEs). In Shih et al. (2012) proposed a knowledge management architecture to facilitate knowledge management within a collaborative supply chain. Rodríguez-Enríquez et al. (2015) proposed a linked data-based approach using simple knowledge organization system to manage the knowledge from supply chains.

A supply chain is an integration of various business processes to deliver what is of value to the customers. Organisations that work sufficiently long time generate considerable knowledge in terms of expertise that are virtues of an organization. This repository of expertise can be stored, retrieved and deployed as desired with the help of what is called as Knowledge Management System (KMS) (Vishnu et al. 2003). Previous studies have shown that KMS is very important issues for SCM to gain competitive advantage (Li 2007; Janus-Hiekkaranta et al. 2009; Coll-Vinent Silva 2012; Schmitt et al. 2012).

Supply Chain Management (SCM) was born to manage the flow of information, products and service across a network of customers, enterprises and supply chain partners. The success of supply chains depends upon the flow of knowledge among its partners. Chopra and Meindl (2015) go further and state that a Supply Chain (SC) consists of all stages involved, directly or indirectly, in fulfilling a customer request. The SC not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves. Within each organization, the SC includes all functions involved in filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance and customer service. The knowledge exists and appears among the SCM life cycle, functions and process of SCM. Therefore, introducing and developing a Knowledge Management System (KMS) in a SC enhances the creation of knowledge (Coll-Vinent Silva 2012). There is a need for greater industrial research leading to the evolution of KMS in SCM domain as it promises enormous benefits of improved cost, flexibility, delivery and quality (Wadhwa and Saxena 2005).

To illustrate, Gaumand et al. (2011) claimed that implementing KMS in SC makes SC actors change their cognitive scheme and work practices. As well as implementing KMS in SC in companies contribute to gain sustainable competitive advantage. On the contrary, Coll-Vinent Silva (2012) who designed a new knowledge management system within the supply chain in technological firm, claimed that the employees feel reluctant to openly take part in knowledge management initiatives to make public what they know. Such research finding addressed problems that still exist in coordinating KMS efforts for Supply Chain (SC) participants. Most of the components in SCM work in isolation and achieving coordination among SCM partners turns out to be a difficult proposition. Further research efforts are needed to view KMS efforts from the SC perspective and study the related enabling environment and organization impact of collaborative KM (Li 2007).

Researchers have also argued that SCM need KMS to ensure sharing, acquiring, storing the knowledge (Kinney 1998; Davenport and Prusak 2000; Hurley and Green 2005; Wadhwa and Saxena 2005; Li 2007; Janus-Hiekkaranta et al. 2009; Coll-Vinent Silva 2012; Schmitt et al. 2012). A KMS is a special type of information management system for managing the knowledge resources of an organization, viewed essentially as an enabling technology for effective and efficient knowledge management towards providing a knowledge repository in/ for an organization. A KMS involves creating, generating, capturing, storing, sharing and using knowledge to support and improve the individual performance of members in an organization (Kinney 1998; Davenport and Prusak 2000; Hurley and Green 2005). Incidentally, a KMS is different from information systems in that they focus on the complex and specific task of facilitating KM process.

In essence, the purpose of building KMS is a support system for knowledge within communities-of-practice (Walsham 1993), constructed exclusively to facilitate the exchange and assimilation of knowledge (Alavi and Leidner 1999). However, due to the extensive cut backs and subcontracting that characterized global business in recent years, a lot of organizations began to acknowledge a resulting loss of 'core competency knowledge' from within the business, as an increasing number of employees leave the organization(Schmitt et al. 2012). In response to this rising problem, the SCM indus-

try, for instance, has accelerated KA among its members (Afolayan et al. 2016). The member of SCM namely are; suppliers, producers, transporters, retailers, whorehouse unit, and delivery unit. Where each member and units in SCM has knowledge as; management of supply (stock analysis, estimation of suppliers, procurement and transportation); transportation (types of vehicles, grouping of loads, multi-modal, transit, etc.); production (projects, commissioning, releases, assessment, control of quality, optimal lots size, etc.); and warehouse and delivery (arrival of goods, review, reception, storage, picking) (Arango et al. 2014).

Knowledge acquisition is a process of translating implicit knowledge into explicit form (Brulé and Blount 1989). For example, the tacit and explicit knowledge that the supply chain management have to translate are; the tacit knowledge(innovation, learning, culture, intangible, problem solving, experience and decisions) (Neumann 2007; Ge guo and Li 2008; Zhang and Hong 2009; Samuel et al. 2011), and explicit knowledge (documents about product design, production schedule, inventory level and delivery schedules) (Zhang et al. 2007; Deng and Peng 2008; Keqin and Shurong 2008; Done 2011).

According to Partridge and Hussain (1994) " knowledge acquisition is a very labour-intensive activity. It is almost an art-form with questions arising for which there are no algorithms or computer programs". Extensive researches have been conducted on ways to improve the knowledge acquisition process. Moreover, the knowledge acquisition process has been focused on for the partial/full automation with the help of AI techniques. (Kang 2004; Tseng et al. 2013). Prior knowledge acquisition studies in the supply chain have however primarily confined themselves to knowledge transfers and sharing issues including ambiguity, optimization, risk reduction, and knowledge acquisition from the partners in the SC (He et al. 2013; Afolayan et al. 2016; Xiaodong et al. 2009; Min and Yu 2008). Not many studies have been dedicated to the actual automation of knowledge acquisition in the SC, and to the potential opportunities that can be harvested from automated knowledge acquisition (e.g (Sun 2008; Ma and Nie 2009; Xiaodong et al. 2009).

Clearly, SCM need to facilitate the realization of providing high quality service,

knowledge and information sharing among departments (Tse et al. 2009). The utilization of information technology is taking up momentum to meet this objectives. Within this setting, the utilization of artificial intelligence (AI) technologies have achieved significant attention for achieving agility of SC flow, which plays an important role in enhancing logistics service and quality. AI can be used for organizing and structuring a reliable, fast and practical procedure for executing quality evaluation, cost effectively (Tse et al. 2009).

Despite considerable research on the knowledge management system in supply chain management (Rodríguez-Enríquez et al. 2015), the field has been described as still in an initial growing (Rodríguez-Enríquez et al. 2015) within the domains of knowledge acquisition (Sun 2008; Ma and Nie 2009; Xiaodong et al. 2009). Within this context, knowledge acquisition enhances overall supply chain performance (He et al. 2013). For instance, Rodríguez-Enríquez et al. (2015)propose a linked data-based approach using the Simple Knowledge Organization System (SKOS), in order to manage the knowledge from supply chains. More specifically, Sun (2008)examined knowledge acquisition in the case of vegetable supply chain, to address the unsatisfied results of retrieval, particularly when the data base information is extensive. The author developed the application on the basis of ontology and its purpose was to comply with the retrieval habits and the timings of users as this could prevent lack of intelligence found in traditional methods of retrieving keywords. The author stressed on the need for further studies to examine the minimization of risks in knowledge acquisition. Xiaodong et al. (2009) proposed a fuzzy case-based reasoning (FCBR) framework that was developed in product style extraction by using linguistic variables. Complementary to this Ma and Nie (2009) developed a qualitative risk model with the data of Yangtze River Delta of China, to empirically identify the important risk factors of Knowledge Management for the supply chain Logistics in mergers and acquisitions.

SCM requires the comprehension of complex, interrelated decision-making processes and the creation of intelligent knowledge bases crucial for joint problem-solving (Min 2010). For supply chain a previous studies were conducted to automate supply chain through the agent-based models and Case Based Reasoning(CBR) (e.g (Min and Yu 2008; Fang and Wong 2010; Garg et al. 2011; Fu and Fu 2012; Long and Zhang

2014)). The rationale of adapting CBR in KMS is to facilitate the retrieval of knowledge from past/archived cases (stored in a case repository) for application to/in new (and similar) problems. The key merit of CBR is the reduction of effort in knowledge acquisition, as enabled by the adaptation and reuse of knowledge from past cases. The modality of the CBR is the establishment of 'case behaviors' (pooled in a repository), which guide the knowledge retrieval process in identifying a new case that has an identical problem description from the (pool of) past cases. This mechanism ensures that newly adapted knowledge can be consistently exchanged and reused in the knowledge repository.

This chapter presents an overview and general introduction to the thesis, which include the identifies of the research problem, research objectives, Research questions, research scope, the significant of this study, the terms of this research and the structure of this thesis.

1.2 PROBLEM STATEMENT

Recently, a lot of organizations and industrial companies realized the need for knowledge to be acquired in order to solve many problems associated with the manufacturing process, such as slow process techniques, high material consumption, and poor machine quality (Xin et al. 2006a; Cheng Ling and Nasurdin 2010). In the SCM, several issues have to be addressed prior to its practical applications (e.g., human interaction (Giannakis and Croom 2004)), knowledge (strategic and operational aspects) and knowledge acquisition among the members of the supply chain. The focus of this study is the knowledge acquisition of different supply chain members as brought forward and emphasized on by several prior studies due to its importance (Janus-Hiekkaranta et al. 2009; Coll-Vinent Silva 2012; Schmitt et al. 2012). More specifically, Spens and Bask (2002) related the issue's importance to the linkage of the different members of the supply chain. Industrial companies can enhance their organizational learning, and in turn, their performance through successful acquisition of knowledge. Added to this, successful knowledge acquisition can also pave the way for them to develop possibilities of obtaining competitive advantages.(Ahmad 2011).

Added to the above, the knowledge acquisition method were initially proposed for the transformation of implicit to explicit knowledge by using manual methods of interviewing, tracking the reasoning process and keeping track of documented and non-documented knowledge. They aim to determine the information and knowledge that is useful and their methods of use (Wagner et al. 2001; Kang 2004; Sagheb-Tehrani 2006; Ullah Amin and Khan 2009). Knowledge acquisition has been examined from the theoretical perspective to indicate its relationship and impact on SCM (e.g (Li et al. 2010; Kim et al. 2011; Liao et al. 2010; He et al. 2013; Liao and Marsillac 2015)), while its technical perspective has got a little of attention.

From these scarce studies, Sun (2008) examined knowledge acquisition in the case of vegetable supply chain, wherein the application addresses unsatisfied outcomes of retrieval in the extensive database information. The application was created on the basis of ontology and to comply with the retrieval habits and timing of users and to prevent issues arising from traditional methods of keywords retrieval. The researcher highlighted the need for further researches to look into the reduction of knowledge acquisition risk. Similarly, Xiaodong et al. (2009) brought forward a fuzzy case-based reasoning (FCBR) framework in product style extraction using linguistic variables, claiming the need for knowledge acquisition in its product style. The need of knowledge acquisition appeared through acquire the ability to process complex information more quickly if initial processing objectives establish the need to gain additional knowledge. Complementary to this Ma and Nie (2009) provided that qualitative and quantitative studies on the scope of knowledge acquisition in supply chain is still few and far between. In the supply chain no decision maker can have all the necessary knowledge about the processes or core resources used in the whole supply chain, and it becomes a lot more difficult to obtain access to and re-use the necessary knowledge that is not created by oneself to make efficient and effective decisions such as waste reduction and elimination. Liu et al. (2013) related that decision makers at different supply network levels have different preferences and priorities.

Studies confined their examination to outsourcing of R&D activities for technological knowledge acquisition, and ultimately for product innovation (Grimpe and Kaiser 2010; Berchicci 2013; Bianchi et al. 2015; Lee and Huh 2016). Denicolai et al.

(2014) focused on KM and the various mechanisms affecting the creation, retention and transfer of knowledge.

In SCM, KA has to keep various issues under consideration, particularly product functionality in manufacturing bulk quantities of products lest the product may disappear. Designer staff has to store functions and parameters during product development (Janani and Devi 2013). Knowledge acquisition in SCM calls for different approaches in future technical research although some authors have brought up the subject of supply chain automation (e.g., (Hassan and Soh 2005; Kwon et al. 2007; Fang and Wong 2010; Garg et al. 2011; Fu and Fu 2012)). Knowledge technology strategies are needed to bring about KA by identifying the resources and capabilities of knowledge to be utilized. This leads to the question as to the interrelationship of the SC knowledge, knowledge classification and system tools used in such knowledge acquisition.

According to Keqin and Shurong (2008)), stress has to be placed on identifying key knowledge, recording, storing and reusing knowledge, and knowledge that is valuable to the firm. Those identification steps are required for KA success in organizations (Cummings and Worley 2005; Nemani 2010a).

Moreover, knowledge classification in SCM is the platform upon which processes of KM is based on. Studies have classified knowledge on the basis of their framework into tacit and explicit knowledge (Nonaka and Takeuchi 1995; Polanyi 1997; Little 1998; Group 1998; Fuchs 2002). Tacit knowledge is personal, context-specific and is hard to formalize and communicate, whereas explicit knowledge can be transmitted in formal and systematic language (Nonaka and Takeuchi 1995). Knowledge was also categorized into internal and external elements, with the former taking place within the firm, and the latter from outside source through acquisition or imitation. Zhang et al. (2008) classification is based on qualitative and quantitative knowledge, while others focused on reusable knowledge (Smirnov and Chandra 2000), project knowledge (Neumann 2007) and bilateral classifications in enterprise knowledge (Nath et al. 2005). Some others also classified it based on internal-external criterion Hall and Andriani (1998); Meixell et al. (2002).

Knowledge has also been classified into formal and informal knowledge – the former exemplified by research reports, marketing material, process and methods and the latter by tacit knowledge. Majority of organizations employ community-based e-discussion coupled with database lessons to relay knowledge from personnel to repository (Sezgin and Saatçıoğlu 2011). Studies have classified the supply chain knowledge throughout organizational boundaries into supply chain functions like planning (Smirnov and Chandra 2000; Flscher and Stokic 2002; Wadhwa and Saxena 2005; Neumann 2007; Zhang et al. 2007; Deng and Peng 2008; Ge guo and Li 2008; Keqin and Shurong 2008; Zhang et al. 2008; Zhang and Hong 2009; Done 2011; Samuel et al. 2011), production (Flscher and Stokic 2002; Wadhwa and Saxena 2005; Neumann 2007; Zhang et al. 2007; Deng and Peng 2008; Ge guo and Li 2008; Keqin and Shurong 2008; Done 2011), warehousing (Wadhwa and Saxena 2005; Done 2011; Samuel et al. 2011), transportation (Wadhwa and Saxena 2005; Samuel et al. 2011) and delivering (Zhang and Hong 2009; Done 2011; Samuel et al. 2011) but only a few have touched upon KA automation (e.g (Sun 2008; Ma and Nie 2009; Xiaodong et al. 2009))to simplify KA.

In this background, Artificial Intelligence (AI) techniques based on KMS in SCM (Tse et al. 2009) has key role to play in knowledge acquisition, storage and reuse, with the most common methods being Case Based Reasoning (CBR) and Intelligent Agent (IA) (Min and Yu 2008; Fang and Wong 2010; Garg et al. 2011; Fu and Fu 2012; Long and Zhang 2014). Knowledge acquisition issues have increasingly been reported in the industrial domain indicating their inclusion in the SCM (Tse et al. 2009). In AI techniques, the argument for their feasibility has been rampant, particularly for SC issues – studies of this caliber include Wu (2001) who addressed the coordination issue among multi-agent systems and the way they enhance knowledge sharing. Also, Zhang et al. (2007) developed multi-agents on KM along the SC for buyers-sellers information overload online, while Mogos and Socoll (2008) looked into IA use on KM in online business environment to examine knowledge sharing in SCM. Their findings showed that IA technology use on KM e-business is efficient and effective enhancing buyers and sellers' interaction. This indicates the suitability of hybridization case-based reasoning and IA to support optimal outcomes. In this regard, (Fang and Wong 2010) proposed the integration of IA with CBR for bargaining offers and retrieval of suitable

cases from storage, making use of prior cases to solve new issues, and effective adaptation algorithms to bring about the adaptation to the new situation. Garg et al. (2011) also proposed the same in the form of multi-agent and case-based reasoning collaboration for SCM, and Fu and Fu (2012) examined the combination of CBR and multi-agents to solve inter-organization supply chain management. They found it to enhance firm competitiveness and address issues like SC cost management.

In sum, the AI approach feasibility when coupled with automated knowledge acquisition in SC provides several issues that have to be addressed; the lack of existing research, lack of technical background in KA in the SC, and lack of knowledge repositories and knowledge flow. Review of literature shows the following limitations in studies; lack of studies concerning the drawbacks of knowledge storage and reuse in the SC as a result of which firms fail in implementation and face decision making risks (Zhou and Li 2011), KA weaknesses, majority of which knowledge is generated from the SCM daily (Cvilikas et al. 2007), lack of knowledge database (Diaconu et al. 2014), and lack of studies focused on fully automated supply chain (Sun 2008; Ma and Nie 2009; Xiaodong et al. 2009), focused on knowledge types, storage and acquisition throughout the SC partners. Consequently, further studies are needed to identify knowledge types held by supply chain partners, model knowledge types based on the SC functions, develop KA framework based on IA-CBR integration. Accordingly, this study identifies the knowledge types, develops the KA framework by integrating CBR-IA in order for SC partners to store, reuse and acquire knowledge effectively and efficiently.

The problem to be resolved by this study is whether by identifying and classifying the types of knowledge, and the development of knowledge acquisition framework based on integrating CBR and IA will enable the supply chain partners to store, reuse and acquire the knowledge based on supply chain functions.

1.3 RESEARCH QUESTIONS

In the context of the supply chain management, this research seeks to answer the following main research questions:

1. What are the types of knowledge that can be acquired among supply chain partners?
2. How are the supply chain knowledge interrelated?
3. How can the knowledge in supply chain functions be classified?
4. How can CBR and IA be integrated in automating knowledge acquisition in the supply chain management?
5. How can the prototype of automated knowledge acquisition for supply chain management be validated?

1.4 RESEARCH OBJECTIVES

Based on the problem statement, the aim of this research is to develop a framework for automated knowledge acquisition based on supply chain functions, within the artificial intelligence approach namely case based reasoning and intelligent agent. To achieve the aim of this research following main objectives are outlined:

1. To identify and interrelate the types of knowledge that gain concerned among the supply chain partners.
2. To model knowledge types in the supply chain based on supply chain functions.
3. To propose a framework based on the integrating of CBR and IA to enable the supply chain partners to store, reuse and acquire the knowledge based on supply chain function.
4. To validate the proposed framework through the development of an automated knowledge acquisition prototype.

1.5 RESEARCH SCOPE

The research attempts to provide a framework for automated knowledge acquisition in supply chain management in manufacturing industries. Manufacturing industries and logistics providers expect to benefit from the research by acquiring, storing and reusing their knowledge pro-actively. Data collection involves interview and case study. The

respondents of the interview to collect data and validated the prototype are supply chain members which include: (customer, supplier, manufacturer, deliverer, warehouse staff, transporters and retailers) from a Malaysian large manufacturing food company. This research applied the case study in order to ensure better understanding of knowledge flow and knowledge types among supply chain partners in order to design a framework of automated knowledge acquisition for SCM. In addition, this research integrated CBR and AI to develop automated knowledge acquisition for supply chain management. After the initial conceptual development and modelling of supply chain knowledge, the research further develop and validate the proposed framework through the knowledge acquisition prototype that was developed.

1.6 SIGNIFICANCE OF THE STUDY

In literature, although studies have a consensus on the need for automated knowledge acquisition, no solid evidence has been reported as to the nature and direction of such automation in both practice and structure of supply chain management. Therefore, this study is an attempt to minimize the gap in literature by providing new information on knowledge acquisition, artificial intelligence and supply chain management systems. This study contributes to the academic IS and management literature by tackling an issue that is of importance to both academic and practitioner circles.

The present study's contribution to supply chain management knowledge may also be invaluable for firms in their setting up of knowledge acquisition system that entails the storage and reuse of knowledge, and the tools required. As a subsequence, other studies of supply chain management field can use the findings to further examine the knowledge types required in the supply chain management of manufacturing firms. Along a similar line of contribution, practitioners may also use the information concerning knowledge and tools that are needed for the supply chain management to function smoothly.

Moreover, the study findings may stimulate further research in the field to examine and explain knowledge technology that can arise in supply chain management that

can facilitate decision making.

Added to the above contributions, this research adds knowledge to the academic field by providing empirical validation of the conceptual framework for the analysis and exploration of the supply chain knowledge and for the development of the knowledge repository. In this study, an automated knowledge acquisition framework was developed and proposed for supply chain management to facilitate the right knowledge acquisition at a timely manner. The present research provides an insight into the knowledge types along with a suitable framework for knowledge acquisition and as such, develops the theoretical knowledge regarding the field, the practical knowledge as well as knowledge on methodology. More importantly, this research is one of the first of its kind that empirically examined the knowledge types affecting the development of automated knowledge acquisition for supply chain management in a food manufacturing company.

1.7 TERMS AND DEFINITIONS

The following definitions clarify the meanings of central terms used in this research. While the definitions do not aim to describe the respective terms in a holistic way, they narrow the meanings of these terms to provide explanations of how they are used within this work.

1.7.1 Supply Chain

Chen and Paulraj (2004) stated that a typical supply chain is a network of materials, information, and services processing links with the characteristics of supply, transformation and demand. The supply chain is referred to as the ‘logistics network, consists of suppliers, manufacturing centres, warehouses, distribution centres and retail outlets as well as raw materials, work-in-process inventory, and finished products that flow between the facilities’(Simchi-Levi et al. 2009). In the context of this research, supply chain refers to a set of facilities, supplies, customers, products and method of controlling inventory during production, delivering and distribution of products.

1.7.2 Supply Chain Management

The supply chain management is made up of a set of approaches employed to bring about the efficient integration of suppliers, manufacturers, warehouses and stores, with the aim of producing and distributing the right quantities of merchandise to the correct locations in a timely manner. This ultimately leads to the minimization of overall coasts while at the same time meeting the requirements of service level. (Simchi-Levi et al. 2009). Mentzer et al. (2001) define SCM as the "systemic,strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain,for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole." According to Hugos (2011) "Supply chain management is the coordination of production, inventory,location,and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served." In the context of this research, supply chain management refers to the activities involved in the transformation of goods from the raw material stage to the final stage when the goods and services reach to the customer

1.7.3 Supply Chain Knowledge

Every supply chain function holds knowledge that contributes to reaching decisions (Vishnu et al. 2003; Smirnov and Chandra 2000; Zagnoli and Pagano 2001; Lin et al. 2002; Higgins 2003; Neumann 2007). Supply chain knowledge refers to the knowledge resources acquired from the supply chain members to gain economic benefits (Craighead et al. 2009). In the present study, supply chain knowledge is defined as the knowledge based on SC functions, which can assist the supply chain partners to gain competitive advantage.

1.7.4 Knowledge Acquisition

Knowledge acquisition refers to a process of transforming implicit to explicit knowledge (Brulé and Blount 1989). In relation to this, Turban et al. (2007) described knowledge acquisition as involving the acquisition of knowledge from experts, books, documents, sensors or computer files. The obtained knowledge may be focused on a specific domain or to procedures of problem-solving. It may the form of general knowledge or meta-knowledge – the former being knowledge concerning business and the latter being knowledge concerning the information of the way experts use their knowledge for problem-solving and the procedures used. Knowledge acquisition has also been referred to as the process involving the access and absorption of knowledge via direct/indirect contact or interaction with the sources of knowledge (He et al. 2013).

In the present study, knowledge acquisition is defined as the process of acquiring knowledge from within or outside the firm that covers the acquisition process and the learning process of suitable knowledge from internal and external resources including experiences, experts, important documents, plans and others.

1.8 THESIS OUTLINE

In this section, the research process of the thesis is presented. The structured approach followed for carrying out the research is presented in Figure 1.1. From the outline, different stages are presented including the identification of research gap, research methodology, exploratory case study, evaluation and finally conclusion. The thesis is organized into chapters in the following way;

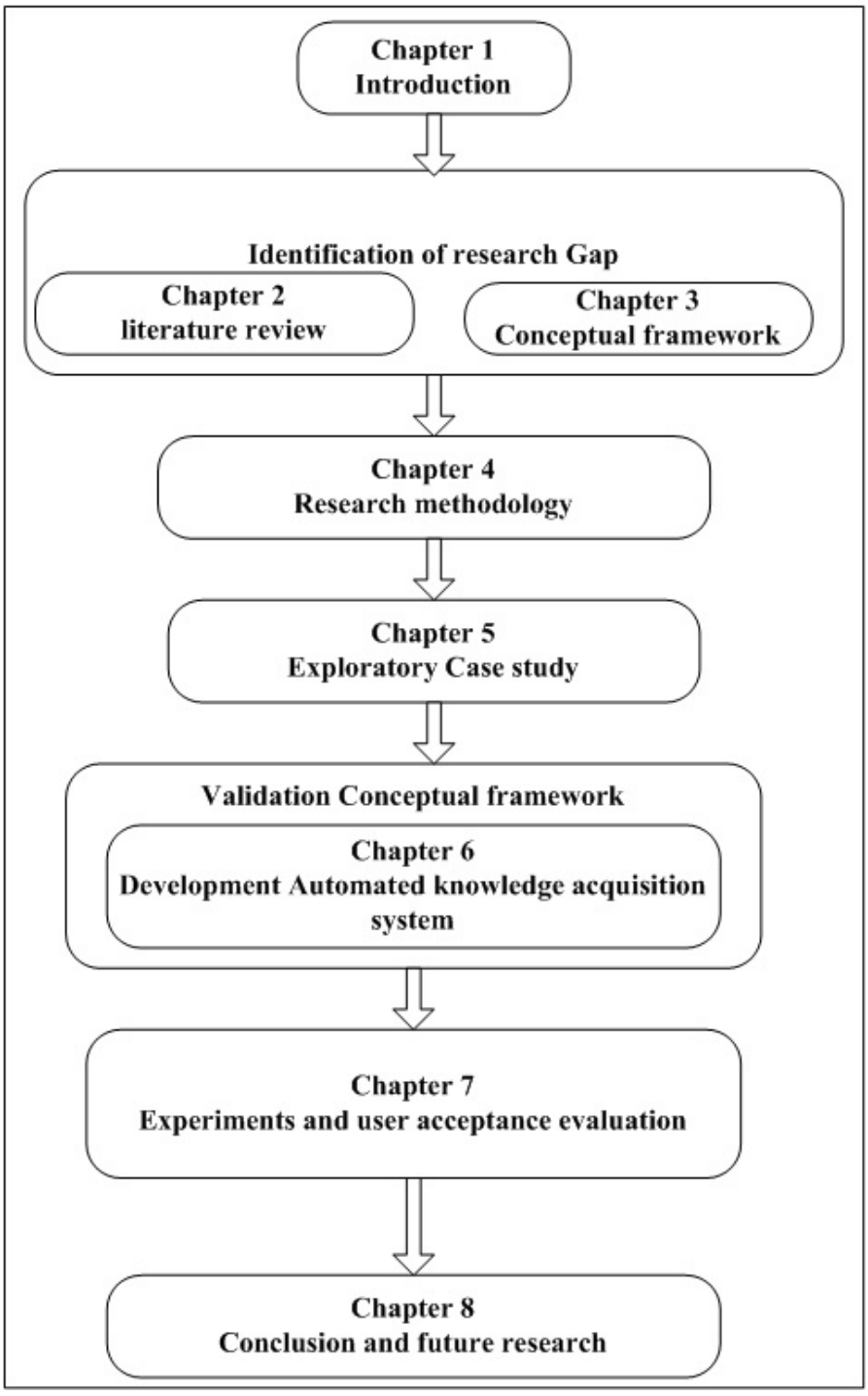

Figure 1.1 Outline of the thesis

The first chapter contains the introduction of automated knowledge acquisition framework in the SCM. The chapter also contains the research questions, objectives and research contributions. The study's problem statement is also presented. This is followed by the second chapter that provides the automated supply chain knowledge

management and a robust and thorough literature review. The review of literature provides three specific research gaps in the perspective of the industry while defining the study's problem statement.

The third chapter then develops the automated knowledge acquisition framework for SCM, beginning from conceptual ideas produced from the literature review. The chapter explains the framework dimensions and it concludes with the presentation of the research framework.

The fourth chapter provides a discussion of different approaches to achieve the research objectives. The chapter also presents different research paradigms and methods in the development of the study research design. The research process highlights that an exploratory case study is capable of encapsulating the holistic picture of knowledge acquisition in the SC. The chapter provides the qualitative methods and their justification of use in this research. This is followed by the fifth chapter that discusses the case study use in the development of the modelling stage base. The case study is based on the manufacturing firm industry and it aims to examine the knowledge types, knowledge storing, acquisition and the process of problem solving across the SCM.

The sixth chapter proceeds to validate the automated knowledge acquisition framework for SCM by developing the system and discussing each part of the conceptual framework presented in the third chapter. This is followed by the seventh chapter, where the automated knowledge acquisition prototype is evaluated to guarantee that its basis on CBR-IA approach is feasible and can play a key role in the acquired knowledge performance. The evaluation also verifies that the automated knowledge acquisition prototype is accepted among the users.

Finally, the thesis is concluded by the eighth chapter. The chapter provides the discussion of outcomes in light of the research questions and presents the contributions, significance and limitations of the research. The appendix section contains information on the research results presented in research posters format, workshops as well as conference presentations. The appendix also presents measurements that used in this study and short abstracts of the journal and conference publications cited and used to support

the activities conducted in the research.

1.9 SUMMARY

This chapter introduce the background of the study. Basically, the research focuses on knowledge acquisition development framework in the context of supply chain management, particularly in the food manufacturing firm. knowledge acquisition is considered as a backbone in SCM. In order for knowledge acquisition to be considered a backbone to SCM it must be effective. However, the way to acquire the knowledge may not always be effective. Nonetheless, there has been relatively little research conducted concerning knowledge acquisition in SCM. The evidence from limited literature suggests that currently there is no approach for knowledge acquisition and no tool for this purpose. To fill part of this gap in the knowledge acquisition in SCM literature, this study intends to develop and design automated framework based on the two parts; namely, modelling of supply chain knowledge and combination of CBR with IA techniques. The selection of these parts was generated from the problem statement and research gap discussed in detail based on the literature review. With the limited study on technical and theoretical perspectives for automated knowledge acquisition in supply chain management setting, the research aims to improve the acquisition, storage and reusing knowledge among supply chain partners by introducing the knowledge acquisition framework that can be implemented by supply chain management. In order to achieve the research aims, the study outlined five research questions with four research objectives to support the framework development and evaluation. The scope of this research is a food manufacturing firm because only selected supply chain members that pass all the criteria stated by the researcher will be selected as the unit of analysis. In literature review chapter, the researcher discusses in detail the approaches and their relevance to the concept of interest. In the conceptual framework chapter, the researcher proposes the automation knowledge acquisition framework. In the research methodology chapter, the researcher discusses the relevant method used in the research to conduct,collect and analyse the data. In case study chapter, the researcher explains the case study and analyse the data that collected. in development chapter, the researcher develops the automation knowl-

edge acquisition prototype. Finally, in conclusion chapter, the researcher discusses the outcomes, contributions, significance, limitations and recommendations for further research.

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, literature from various disciplines regarding knowledge acquisition and supply chain management are reviewed to highlight the gaps in literature and the related conceptual and theoretical frameworks. Accordingly, the chapter aims to stress on the major directions and themes in the field to develop an in-depth understanding of the phenomenon under study.

The chapter begins by conducting an evaluation of the knowledge management system literature and its relationship to knowledge acquisition in an attempt to improve the supply chain knowledge. Such a review can examine the studies related to the knowledge acquisition development that is the primary focus of supply chain management. This is followed by the review of literature on knowledge acquisition in different fields (e.g., medicine, engineering, business and supply chain) highlighting the need for knowledge acquisition.

The literature on supply chain knowledge is explored to develop a guideline to study the types of supply chain knowledge and to identify the types, process and method of knowledge acquisition, as well as to recommend suitable ways to minimize the gap in literature. The review also provides an in-depth insight into the concept and how to appropriately examine it.

For the determination of the adaptation of artificial intelligence, studies dedicated to the aspects of the CBR and IA in knowledge acquisition in the SCM are reviewed. In so doing, the researcher can also address the gaps in literature and develop

the research questions. Lastly, the chapter conclusion is provided.

2.2 KNOWLEDGE MANAGEMENT SYSTEMS

This section first provides the definition of relevant terms of data, information and knowledge. Data refers to the raw inputs of individual facts, statistics or items of information (Standing and Benson 2002), while information refers to processes data (Vance 1997; Bellinger et al. 2004). Lastly, knowledge refers to the understanding of the meaning or implication of information (Benson 2008). Added to the above, knowledge can be categorized into tacit and explicit knowledge (Nonaka and Takeuchi 1995; Polanyi 1997; Little 1998; Group 1998; Fuchs 2002). Specifically, tacit knowledge is described as knowledge that is difficult to describe like skills, experience or native talent, while explicit knowledge is described as skills and facts that can be documented and taught to others (e.g., technical documents (Polanyi 1997)).

From the mid-1970s, knowledge became the focus of increasing scrutiny for its role in organizational strategy and a decade later (in the 1980s), the significance of organizational knowledge became established. Since then, organizations have concentrated on the processes and strategies required for innovation management and knowledge building (Leonard 1995; Ellis 2003). Consequently, systems were created to become platform basis for knowledge management. Knowledge management is a term that is viewed as the management of activities related to knowledge including general, multidimensional knowledge and it encapsulates different activities of the enterprise (Wiig 1997). For instance, MediaOne knowledge management project for Shared Corporate Resources group was initiated in 1998 in order to reinforce shared corporate resources as well as the experiences of the individuals positioned throughout the enterprise (Robertson 2002; Howell and Annansingh 2013).

KMS is a specific kind of information management system that managers the organization's knowledge resources and is primarily considered as the technology that enables the effective and efficient management of knowledge by developing a knowledge repository. It entails the creation, generation, capture, storage, sharing and use of

knowledge in the quest to support and enhance the performance of organizational members (Kinney 1998; Davenport and Prusak 2000; Hurley and Green 2005). Moreover, KMS is distinct from information systems as the former focuses on the complex task of bringing about sharing of knowledge.

Several approaches have been proposed as to the way knowledge management (KM) can be used in the organization. First involves the repository model that focuses on information management and knowledge-reuse in tangible formats. According to King (2009) KM has its basis on the notion that similar to human beings that are incapable of drawing the complete potential of their minds, organizations cannot fully use the knowledge that they have. Organizations use KM for useful knowledge acquisition or generation and to disseminate it to those who need it at a suitable time and place in order to realize the maximum effective use and in turn, positively affect the performance of the organization. Generally, an organization that can maximize such effective use of knowledge by a small percentage can reap great benefits from it. According to Mládková (2011) knowledge management addresses critical issues of the way the organization adapts, survives and competes in the face of dynamic environmental changes. In essence, knowledge management system represents the organizational processes that require the synergistic combination of data and information processing capability of information technology and the creative and innovative capacity of the human beings. It is also viewed as making a direct relationship between the intellectual assets of the organization (Barclay and Murray 1997), in what is considered as a legal approach. It addresses intellectual capital, copyright, patents and trademarks. Moreover, knowledge management may also be considered as business intelligence in that it is a process that generates significant current information to use in decision making pertaining to operations and strategies (Hannula and Pirttimäki 2003; Chung et al. 2005).

2.3 KNOWLEDGE ACQUISITION

The acquisition of knowledge refers to transforming implicit knowledge into explicit knowledge (Brulé and Blount 1989). According to Kaur and Sengupta (2014) the domain of knowledge may cover knowledge from books, researches, case studies, refer-

ence manuals, extant prototypes and systems, among others. Owing to the extensiveness of the knowledge domain, the KA process can involve labor-intensive activities and therefore a systematic approach has to be followed. It is akin to an art-form, where questions arise that cannot be described through algorithms or computer programs.

Several in-depth researches have been carried out to enhance the KA process, particularly to partially or fully automate the process via artificial intelligence (AI) methods (Hoeschl and Barcellos 2006). In this regard, the partial or semi-automatic approach enables the minimization of knowledge experts-knowledge engineers interaction, whereas the automatic one uses AI technique and enables experts to develop their own knowledge platforms with little to no assistance from the engineers (Turban et al. 2007). This is exemplified by the use of AI techniques (e.g., neural networks) by the researchers to create algorithms acquiring knowledge from data in an autonomous manner.

The KA field has been extensively examined from initial automated machine learning approaches (e.g., (Alnwaimi et al. 2013)), to semi-automated knowledge engineering ((Wang et al. 2006)) , to stronger automated approaches like neural networks, and symbolic rule learning (Greiner et al. 2013), and to the current prove, practical methods and successful applications (Tarca et al. 2007), and developed theoretical frameworks (Bareiss 2014). Holder et al. (2006) proposed three fundamental components that make KA successful and the first is the ability to acquire knowledge, and the ability to concentrate on the significance features of the issue (feature selection). The second component is the ability to learn and adapt novel case from its predecessor in terms of chosen features to the categories under interest and third, is the ability to acquire knowledge in increments and to detect knowledge changes in the current dynamic environment.

In relation to the above, Kang (2004) explained that the extensive use of www and internet technologies have led to the expedient knowledge acquisition process, where the www interface is included into the system to obtain complete knowledge based on the perspective of applications. In this regard, knowledge engineers frequently obtain knowledge from experts through the use of interviews that consumes consider-

able amount of time. To precipitate the slow interview process, a knowledge engineer can interview experts through electronic means after which documented knowledge can be relayed through electronic forms that can be stored and retrieved in the knowledge repository. Practically, video-conferencing and web-meeting technology can be utilized to reinforce people networks within the knowledge communities for the purpose of tacit knowledge-sharing. Some other knowledge acquisition methods that are done manually are tracking and observation. The former is utilized to determine the information that used and the way it is used – such manual knowledge acquisition approaches are characterized as slow and erroneous.

According to Partridge and Hussain (1994) the process of knowledge acquisition begins with planning the knowledge base or the repository in knowledge management system (KMS). Knowledge is organized in the repository after eliciting from various knowledge sources. Knowledge is then formulated and represented for making inferences; for instance, a decision table and production rules are utilized for the expression of potential relationships and to determine conditions as well as actions. Following knowledge encoding in machine-readable form, knowledge base implementation is set up. The knowledge base is then deemed ready for testing, after which the knowledge engineer and the domain expert work on verifying and validating it to ensure that the system requirements are in place. It then becomes ready for system testing. The important knowledge acquisition steps in developing knowledge processes are presented in Figure 2.1.

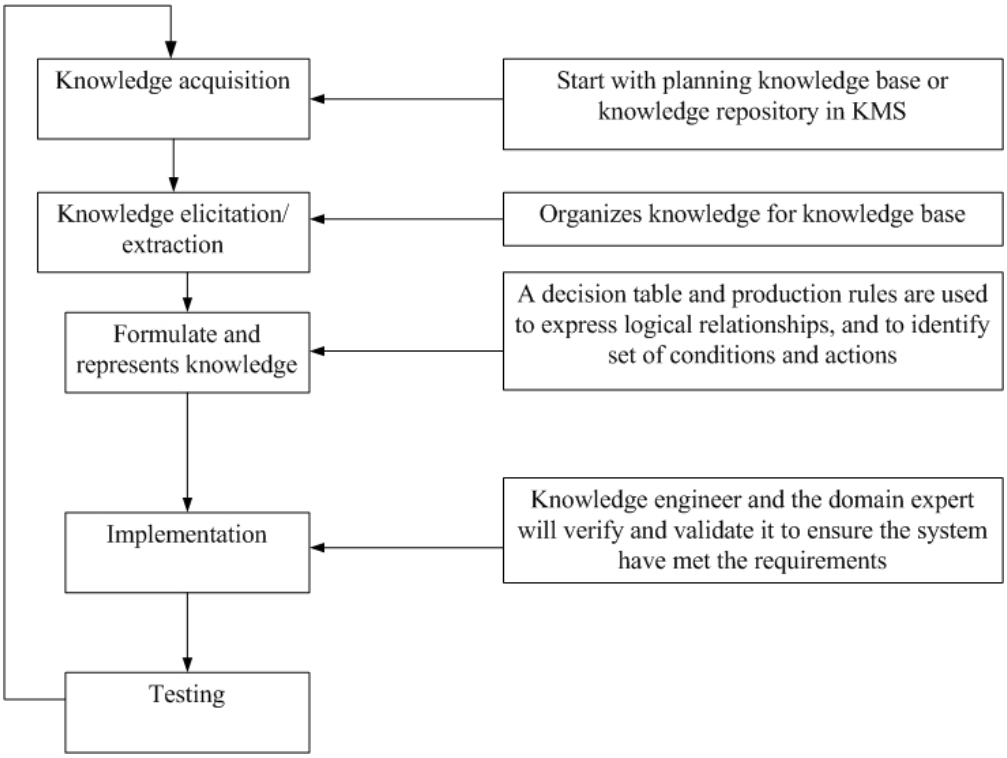

Figure 2.1 Knowledge development processes

Source: (Partridge and Hussain 1994)

KMS is primarily developed for the utilization of corporate knowledge within organizations and knowledge development is examined and implemented in different fields including medical, education, business, and engineering (e.g., in the supply chain management). This research highlights the issues faced in KA in different domains such as medical, engineering, and business; and the different methods used to solve the issues.

In medical domain; KA research has provided two research branches; the first branch contributes to the technical perspective within the domain and is largely conceptual or qualitative. Such studies primarily automated KA in medical domain ((Chen et al. 2008; Wang et al. 2008; Perera et al. 2012; Mendes 2014; Sawka et al. 2015)), and literature indicates that only a few empirical studies have been conducted on how knowledge is acquired via automated KA developed in medicine. The second branch focused on the theoretical perspective, in relation to which literature shows the introduction of acquired medical knowledge and the KA role in medical domain ((Rivas et al. 2016))and the KA provision of optimal decision making (Warren et al. 2012). Ma-

jority of the studies in this second branch of study brought forward theoretical models or frameworks linking KA with the medical domain ((Warren et al. 2012; Hande et al. 2015; Rivas et al. 2016)).

In engineering domain; the most significant aspect of developing KA approach is the knowledge base (Schumaker et al. 2006). This is indicated by the importance of data sharing, artifacts sharing, detailed knowledge and expertise in creating new knowledge (Agt 2011) and to acquire the suitable knowledge (Sjøberg 2007; Micić and Blagojević 2016). Literature also indicates that knowledge acquired can contribute to building a good mechanism to select the most appropriate knowledge externalization technique for specific situations.

Literature in business domain shows several advantages of increased firm knowledge and these include, increased firm's new product development, increased firm's technical competence, enhanced reputation, and decreased cost of sales to customers. Evidence shows that knowledge acquisition has to be conducted from the knowledge source, which is the interaction between the employee and customer. In sum, the firm should acquire such knowledge to increase the knowledge of the effects and success of the business (Studdard 2006; Talet et al. 2011; Suarez-Ortega et al. 2015).

2.4 SUPPLY CHAIN MANAGEMENT

The previous section explained that the supply chain management comprises the entire activities and processes related with the flow of goods and information starting from raw material phase to the end consumer. According to Handfield and Nichols (2003) and Bozarth and Handfield (2015), the activities and processes that take place throughout the supply chain is known as the Supply Chain Management. More importantly, development of an efficient supply chain needs more than attention to information systems and proper communication channels (Mellat-Parast and E. Spillan 2014). Because, there are large amounts of information must be shared along the supply chain. Information systems are the backbone of supply chain business structures, which is used to acquire, process, and transmit information among the parties for effective decision

making (Lyngstad 2009). which It requires reorganizing and restructuring organizational and inter-organizational processes (Richey et al. 2010). To understand the term of supply chain management in depth, first the term of supply chain will be explained, than management and the role of management as a base for complete definition of supply chain management.

The supply chain concept is well-known concept in literature and is described as the consistency of the firms in bringing products/services to the market (Hugos 2011; Felea and Albastroiu 2013). The supply chain encapsulates the manufacturer, supplier, transporter, warehouse, wholesale, retailer, other intermediaries as well as the customer). Additionally, any product traded in the market for consumers, in terms its life cycle from raw material to finished product, goes through varying ongoing transactions on the business to business market. In this regard, Chen and Paulraj (2004) related that typically, a supply chain refers to an interconnection of materials, information, and services processes that are characterized by supply, transformation and demand (see Figure 2.2).

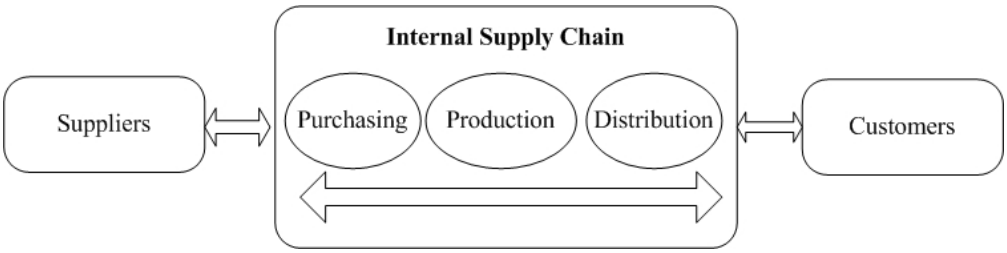

Figure 2.2 An illustration of a company's supply chain
Chen and Paulraj (2004)

Meindl et al. (2013) believes that "a supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. Within each organization, such as a manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance, and customer service". In brief, a typical supply chain may involve a variety of stages. These supply chain stages include: customers, retailers, wholesalers,distributors, manufacturers and suppliers. as

shows in the following Figure 2.3.

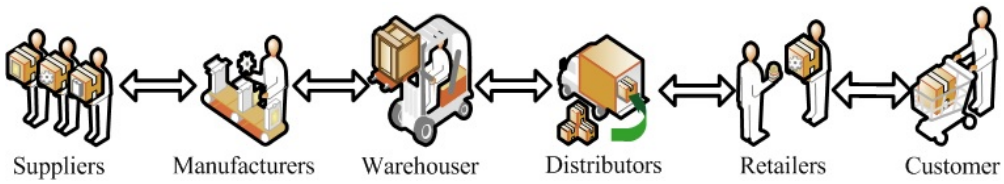

Figure 2.3 Structure of food manufacturing supply chains
Adapted from Meindl et al. (2013)

Majority of authors are of the consensus that SCM holds an important place in the field of management research, where over the past three decades, the SCM concept has been examined by many researchers and practitioners (Felea and Albastroiu 2013). The SCM field was first introduced to manage the information/ product/ service flow throughout the networks of customers, businesses and supply chain partners (Russel and Taylor 2009). From the time of its introduction in the 1980s, supply chain management has gone through multiple changes and modifications as well as extensions.

Throughout the past years, SCM has increasingly been the topic discussed in the circles of researchers and practitioners. In particular, SCM came to the scene following the oil shock in 1973, where inventory holding and moving cost significantly increased, demand decreases along with order quantity, and order frequency increased (Fayez et al. 2005; Kuhl et al. 2005). Businesses were convinced that if they replace the physical inventory with information, it would mitigate the shock and improve their performance. Hence, the eventual supply chain performance hinges on the level to which the entire supply chain management and information is managed and integrated. Supply chain knowledge and information stem from different supply chain partners. Chunks of information are disseminated throughout the network through various systems, formats, details, and other aspects (Fayez et al. 2005).

The main objective of SCM is value creation for the end customers and the supply chain network of the firm. Accordingly, the firms in the supply chain network have to integrate process activities within them and with other related firms. Process integra-

tion is a term that refers to the coordination and sharing of information and resources in order to manage a process together, with integration being a process of redefining and connecting parts of whole for the purpose of forming a new entity (Katunzi 2011).

SCM is rife with issues that are related to the different supply chain levels. The six major elements of SCM provided by Cappello et al. (2008) and the coordination and integration among them are explained as follows; The first one is the service level management, with the inclusion of customer segmentation (Coskun et al. 2016), and service level management (Yoo et al. 2009; Baghalian et al. 2013) and the second one is order and demand management that covers sales demand planning and forecasting (Rexhausen et al. 2012; Chong and Zhou 2014), inventory management (Mittal et al. 2014; Qi and Xu 2014), warehouse management (Qi and Xu 2014) and order entry and fulfillment (Kilger and Meyr 2015; Sürie and Reuter 2015). The third major element is production management that covers network configuration/rationalization (Liu 2011) production planning and scheduling (Maravelias and Sung 2009; Kopanos et al. 2010; He et al. 2014), and production execution (Qu et al. 2014). This is followed by supply management that encapsulates procurement planning (Oddsdottir et al. 2013; Vauhkonen et al. 2014; Dems et al. 2015), supplier performance management (Ren et al. 2012; Forslund 2014; Hassan et al. 2015). The fifth major element is distribution management and it comprises of warehousing (Friemann and Schönsleben 2016), and transportation (Crainic and Laporte 2016), while the sixth one is integrated SCM planning and execution that is enabled by the SCM processes, IT systems, organization and performance measurement (Oh et al. 2015; Srinivasan and Swink 2015, 2017).

Furthermore, SCM comprises of three hierarchical levels (Simchi-Levi et al. 2009) , which are strategic level, tactical level and operational level. The strategic level entails long-term decision making for the supply chain that reflects the supply chain objective and prepares the needed resources for it (Shapiro 2004) like the supply chain network design (Pishvaee et al. 2011; Baghalian et al. 2013; Jabbarzadeh et al. 2016), , and facilities locations (Etemadnia et al. 2015). At this level, decisions significantly affect the supply chain for a significant number of years, even for a decade. At the tactical level, management addresses medium-term decisions on how to go about doing the supply chain to guarantee effective and efficient resources use in terms of strategic

decisions (Esmaeilikia et al. 2014). Typically, the tactical level decisions that are updated after every few weeks to after every other year, are the production and distribution planning (Amorim et al. 2012; Fahimnia et al. 2013; Sel and Bilgen 2014; Yu et al. 2015), policies of inventory (Akin et al. 2014; Jiang et al. 2015). Lastly, at the operational level, highly detailed short-term decisions are implemented into the operations and tasks to achieve the tactical level objectives. The decisions at this level include production and transportation scheduling (Tanimizu et al. 2012; Pei et al. 2015; Guo et al. 2016), and they are often updated after every day or every week.

In this background, (Manzouri et al. 2010), practically provided an overview of the concept, the supply chain levels and elements and highlighted some modifications in the manufacturing area like increased cost, decreased inventory, product life cycle and business globalization. In the context of manufacturing organization's supply chain management is currently viewed as an effective tool to achieve effective supply chain competitiveness (Joshi et al. 2013). The SCM understanding and practicing has become a crucial requirement to stay competitive in the global market and to improve profitability (Li and Lin 2006; Parmar and Shah 2016).

Similarly, in a study by Tai and Ho (2010), the authors explained that in the past few years, manufacturing organizations have concentrated on effective service distribution with physical product to obtain competitive edge. However, although SCM minimizes inventory, facilitates accurate information sharing and develop trust among the partners in the supply chain (Gorane and Kant 2015), it is influenced by issues that are internal and external to the organization like lack of knowledge, lack of top management commitment, top management support, education and training of the workforce, financial resources, IT, ICT as internal issues and disinclination towards information-sharing among supply chain partners, lack of supply-chain collaboration, information sharing, lack of trust among supply chain partners as the external issues (Raj Adhikari 2010; Talib et al. 2011).

2.4.1 Supply Chain Knowledge

Majority of firms invest largely in order to develop and management supply chain knowledge (SCK) as a result of which SCK has garnered considerable attention as a potential performance enhancer, and is referred to as the knowledge in the firm concerning supply chain partners and processes.

An exemplification of the phenomenon was provided by Wowak et al. (2013) who stated that Kenneth Derr, the CEO of Chevron, noted that the efforts of the company to share and manage knowledge throughout the supply chain assisted in mitigating the operating costs by over $2 billion yearly. This anecdote and others like it have been mentioned in research studies dedicated to the practice of SCK and its relationship with performance (Fugate et al. 2009; Craighead et al. 2009; Done 2011).

Majority of the authors and practitioners are of the consensus that SCK facilitates performance enhancements and competitiveness via significant knowledge practices. It is crucial for supply chains to pay attention to the weaknesses of the practices in the supply chain contexts in order to obtain a competitive edge. In sum, some studies noted the need for further research into SCK in order to develop and manage knowledge throughout the supply chain (Wowak et al. 2013). Also, understanding and leveraging SCK in terms of a moderate need should also be looked into by scholars and managers alike.

In a related study, Craighead et al. (2009) explained that considering the increasing view of supply chains as competitive tools that assists firms in outmaneuvering and outperforming their rivals, SCK should be paid more attention to. Similarly, Paiva et al. (2008) revealed that knowledge is specifically significant in this day and age where competition is rampant and is rife with new information sources, new rivals, and shorter product life cycles. Companies depend more on their supply chains and SCK in order to achieve their SCM goals (Lassar et al. 2009). Added to this, SCK has also been evidenced to facilitate strategic alignment of internal capabilities with external environment of the firm in the face of rapid changes (Paiva et al. 2008). In this regard, changes have also been noted in supply chain relationships over time that has led to the dependence

of the firms on SCK development and sharing with partners (López et al. 2012).

SCK is a type of knowledge that seems to have different impacts on its sharing intention, according to the level of criticality and rarity within the industry. Different knowledge types are encapsulated within the automotive industry that range from knowledge related, product line, product design, internal and external logistics to marketing and methods for quality and control (Seyyedeh and Daneshgar 2010). Other studies like Liu et al. (2014) also noted that SCK is established through the knowledge flow from people, departments and organizations, and in the case of supply chain, the KC concept is related to the knowledge flow network. SCK knowledge flow comes in different types, personal group and corporate.

A knowledge chain is also referred to as an interactive, organized and recycling system with the main objective behind its management being the conversion of non-systematic knowledge into knowledge that is understandable and systematic. The major advantages of SCK management are minimization of knowledge constraints by the policy of the organization and promotion of core competitiveness of the supply chain (Liu et al. 2014). SCK come in many times, several of which are customer knowledge (customer knowledge acquisition, mining, sharing, transferring and innovating) (Yong and Yongqing 2015), technical knowledge and organizational knowledge (supply knowledge comprising of goods/service provision and delivery to customers) (Kumari et al. 2015).

According to Ge guo and Li (2008) stated that SCK has two dimensions, which are unique and common knowledge. The unique knowledge of supply chain stems from its members that provide their distinct knowledge that includes, the professional knowledge of suppliers of their technology, parts, components, cost and others, manufacturer knowledge that includes product performance, quality, safety and others, broker's knowledge and consumer's knowledge. Ultimately, consumers can provide feedback on any product, particularly the points that they are satisfied with and those they are not. This knowledge is a resource that manufacturers cannot wait to get their hands on. On the other hand, common knowledge of each member of the supply chain arises from coordination of the supply chain in terms of upstream and downstream as various ad-

vanced methods of the SCM are useless without coordination. An efficient supply chain contains the fine division of professional knowledge and the consistency of knowledge throughout its members that are used as its fundamental criteria. Added to this, the members' knowledge level has to coordinate and complement each other because if the knowledge of a member is confined to himself and the other members are not privy to it, the products and services will lack fall short of meeting the needs of other members, and in turn, this impacts the final product/service quality and performance. This is akin to the internal knowledge in the supply chain that may be relayed throughout the chain or be confined only to some members, but is needed by all. Consequently, this is why it is called the supply chain universal.

With the constant changes in the market environment, the supply chain has to also consider the external exchange of knowledge and not just the internal changes. External knowledge sources should be acquired by each member and relay it to the supply chain and throughout the members creating as much value as possible. Members of the supply chain also include enterprises and individuals (consumers), who hold knowledge on different types of consumers.

Such supply chain knowledge takes on the form of technical know-how, product design, marketing, customer understanding, personal creativity, innovation, among others that add value throughout the supply chain and the partners within. According to Wu and Gu (2009) echoed similar arguments and believed that driven by global competition and continuing expansion of knowledge, firms are pushed to operate with Just-In-Time (JIT) and Mass Scale Build-To-Order (MSBTO) Principles supply chain with their partners to address the market requirement for high levels of modification of the product and fast recognition. Knowledge of customers about such following issues as requirements for future purchase, product quality levels and suppliers' knowledge about managing , and improving design products , schedule production , inventory management and control can be critical for the supply chain, especially among long-term and puts in a stable trading partner as number and request a large diversity of products. In this scenario, the supply chain must be involved in the supply chain such as knowledge of technical know-how, product design, to provide marketing, understands the customer, personal creativity and innovation in order to be operated with JIT and MSBTO.

Corso et al. (2010) proposed a framework to examine the way IT-based solution in the supply chain is aligned with KM need of the firms, while Halley et al. (2010) revealed that the fit between SCM and KM exists, and although the acknowledged attitude within firms is to develop external collaboration connections, the natural relationships that exist in the supply chain is the best network upon which knowledge sharing and creation can be based on.

SCM success can be possible if the organization has knowledge and shares it throughout different processes. Knowledge, in this case, exists within the organization (knowledge of sub-assemblies whereabouts, knowledge of manufacturing delay sources), and external to it (knowledge of the final customers' expectations, knowledge of en-route components and their expected arrival at their destinations) (Sangari et al. 2015).

A truly effective organization is able to bring about knowledge sharing and coordination throughout the supply chain network because lack of such sharing between the members has been evidenced to influence profitability of the firm (Arshinder et al. 2011). Accordingly, (Meixell et al. 2008) contended that KM can improve the success level of SCM efforts and enhance the possibility of successful SCM activities. In this regard, (Eriksson 2015), noted that majority of SCM projects have led to enhanced performance and Shih et al. (2012) revealed that combining KM initiative with SCM processes would assist in raising the performance of the supply chain.

Added to the above studies, López et al. (2012) noted the lack of pre-existing structure that represents SCK and accommodates knowledge of best practices and this lack of structure prevents explicit knowledge capture. Therefore, there is a need to develop a structure for supply chain knowledge containing all best practices as the core source of knowledge and a need to structure knowledge to allow integration and processing of supply chain knowledge (López et al. 2012). This is exemplified by the conversion of implicit knowledge into explicit ones – by capturing and recording knowledge and there is also a need to organize supply chain knowledge in order of compatibility for the eventual desired competitiveness that can be brought about by practices and artefacts that need to be contextualized to particular supply chain configurations. López

et al. (2012) explained that for supply chains to pay attention to the potential weaknesses of the practices in particular contexts and this is possible by structuring and contextualizing the supply chain knowledge. This can also support the successful implementation of knowledge management within the supply chain for the latter to leverage best practices, supply chain learning, operations integrations and strategy development for competitiveness. However, their study limitation relates to the qualitative perspective of the methodology, particularly in which the relationships are introduced into the system, depending on the expert subjectivity of what a best practice is. Therefore, they recommended that in the future, monitoring activity is included, whereby different experts can review the quantified structured information prior to its use in practice within the supply chain.

Tseng (2012) empirically examined the same topic and found that knowledge chain has a key role in mediating between external knowledge and service quality. More specifically, as external knowledge flows from the knowledge base of the firm, it impacts the knowledge chain, prior to the firm's competitiveness through service quality. The above studies illustrate that supply chain knowledge assists in shedding light on the firm's acquisition and leverage of external knowledge for the creation of their competitive advantage.

The structuring and capture of knowledge was also stressed on by Becerra-Fernandez and Sabherwal (2014) who related that the need for both stems from the application of or actionable knowledge. Stated clearly, knowledge application systems reinforce the individuals' use of knowledge possessed by other individuals, without its acquisition or learning (Becerra-Fernandez and Gudi 2008).

The synthesis of studies reviewed in literature produced some interesting observations the first of which is the lack of an SCK framework. Despite the examination of the several studies of SCK (Becerra-Fernandez and Gudi 2008; Wu and Gu 2009; López et al. 2012), there is still a lack of structure of a universal supply chain knowledge. This is pertinent to managers as with it, they will hold the secret to enhancing the performance of the firms.

Second, the findings concerning SCK capture are inconsistent. In some studies, the authors explained knowledge in production line, upstream-downstream of supply chain, consumers series knowledge and customers knowledge (Ge guo and Li 2008; Wu and Gu 2009; Seyyedeh and Daneshgar 2010), where the challenge lies in the capture and record of knowledge (López et al. 2012).

Third, the supply chain knowledge types are inconsistent, with some studies bringing forward knowledge like consumers series, technical know-how, product design, marketing, customer understanding, levels of product quality and suppliers' management knowledge, while others proposed knowledge on enhancement of design products, schedule production, inventory management and control, creativity and innovation.

2.5 KNOWLEDGE ACQUISITION IN SUPPLY CHAIN MANAGEMENT

Knowledge acquisition refers to the access and absorption of knowledge (directly and indirectly) from the knowledge sources (He et al. 2013). Stated clearly, knowledge acquisition is initiated through the identification of knowledge in the external environment of the organization and it ends with the transformation of knowledge to a format that the organization can use (Holsapple et al. 2015).

Knowledge acquisition and creation are important organizational processes that should be continued for the maintenance of competitive advantages in a dynamic environment (Chen et al. 2012). According to the knowledge-based view of the firm, knowledge is an invaluable productive resource and as such, it is crucial for organizations to acquire knowledge from internal resources as well as from peer organizations (Seyyedeh and Daneshgar 2010). The knowledge-based view also proposes that the relative ability of the organizations for knowledge acquisition and development is the reason behind the variation in their performances (Kim et al. 2014). Therefore, knowledge acquisition improves the overall supply chain performance (He et al. 2013). The premise that the firm requires to new knowledge acquisition from suppliers for their product innovation is an old one and the literature review shows that the firm's knowledge acquisition from its supply chain partners can be possible through the following

ways; benchmarking, collaboration or joint problem/solving (He et al. 2013), strategic alliance/technical assistance (Zhang et al. 2010), supplier involvement in development of products (Najafi Tavani et al. 2013), and informal networking (Lee et al. 2011).

More importantly, knowledge acquisition is mainly described as the production of knowledge continuously from prior and new information gathered from the environment. Added to this, the supply chain knowledge may be created based on processes (social and collaborative). Raisinghani and Meade (2005) knowledge can be produced through specific processes including, action learning involving solving problems, concentrating on the learning that is required, and implementation of solutions. More specifically, systematic problem solving requires a disciplined mindset well-versed in reductionism and holistic knowledge, focused on details, and extension of boundaries that work towards underpinning the assessment. This entails learning from past experiences, organized assessment, disseminating and recording lessons that can be later utilized. After the acquisition of knowledge, a main repository for it should be developed to collect for the supply chain as explained by (Hafeez et al. 2000) They contended that companies should carry out knowledge codification in a repository. They showed that knowledge acquisition in the supply chain (SC) is based on each repository in the supply flow. Similarly, knowledge acquisition refers to a socially complex and interlinked concept (Liao and Marsillac 2015). Other authors like Ribeiro Soriano and Parker (2012) focused on the social interaction nature in acquiring knowledge for the purpose of product innovation. According to them, knowledge acquisition in innovation depends on the interaction with the sources of knowledge.

Activities dedicated to acquiring knowledge leads to mitigated time cycle as performance outcomes at the supply chain level and the knowledge development process is a crucial antecedent to the efficiency of the supply chain (Sangari et al. 2015). Regardless of the importance of knowledge acquisition in the supply chain, studies that extensively examined it are still few and far between. In fact, prior studies on the topic have largely concentrated on the knowledge transference and problems-sharing like ambiguity, optimization, reduction of risks, among others (Kwon et al. 2007; Mogos and Socoll 2008; Huang and Lin 2010).

Studies dedicated to the potential opportunities of an automated knowledge acquisition are still scarce (Sun 2008; Ma and Nie 2009; Xiaodong et al. 2009)), as well as the cross-exploratory studies that can potentially stem from such studies. A few studies like Sun (2008); Ma and Nie (2009), and Xiaodong et al. (2009) attempted to develop expert systems (industrial/infrastructure projects) to introduce a supply chain to particularly settings in order to promote flow of ideas, challenges and experiences – this in turn, opens the avenue for new opportunities for learning and obtaining new capabilities for the organization. In the current interrelated global environment, this study has reviewed several studies that lessons can be taken from and one of them being the dire requirement for development and infrastructure, along with the past SC environmental, social and economic errors that needs resolving with plausible solutions. This needs learning commitment from past lessons, knowledge acquisition and sharing and application of such lessons into future projects. In this regard, the learning, knowledge sharing and innovation opportunities stemming from the projects can enhance knowledge acquisition in the supply chain of firms, and the knowledge and performance of it.

Considered from a technical point of view, Sun (2008) investigated knowledge acquisition in vegetable supply chain – their proposed application handles unsatisfied retrieval results, particularly in extensive database information. The application is created on the basis of ontology and it attempted to align with the retrieval process and timing of users to resolve issues of lack of intelligence in traditional methods of the retrieval of keywords. He stressed on the requirement for more studies to examine the mitigation of risk in knowledge acquisition.

In relation to the above studies, Ma and Nie (2009) stated that there is scarcity of qualitative and quantitative studies concerning the knowledge acquisition scope in the supply chain and that not a single study has proposed a knowledge acquisition framework coupled with the supply chain management.

Knowledge acquisition studies appear to be burdened by different labors that are categorized under knowledge technology. Several works have tried, with combined outcomes, to employ knowledge assets via centralization of knowledge technology functions or IT investments. When encountering business phenomenon, knowledge

techniques have to be determined to resolve issues. According to the general premise, knowledge can result in enhanced businesses (Norang et al. 2016) and as such, it is pertinent to acquire knowledge. Such premise has to be supported by empirical findings, and it would be more significant if knowledge is differentiated on the basis of strategy. The question then arises as to how to acquire knowledge rather than whether to acquire it – this needs empirical support.

Prior studies attempted to minimize the above mentioned gap by investigating knowledge acquisition for a specific issue by taking assistance of human experts and knowledge encoding in a computer format. Evidently, the techniques are important for the effective acquisition of knowledge. In current empirical studies, knowledge acquisition, with some focusing on the factors that affect the required knowledge acquisition (Diugwu 2011), while others examined the issues concerning knowledge acquisition risks (Ma and Nie 2009). Some others examined the adherence to the retrieval habits of the user to resolve lack of intelligence in traditional methods of retrieval, especially in a database information that is considerably large (Sun 2008).

Literature highlights that researchers and practitioners have largely under-examined the integrative knowledge acquisition framework despite the necessity of looking into the integrative perspective of knowledge type based on artificial intelligence techniques. Several empirical studies used knowledge acquisition framework of SCM (Sun 2008). In this regard, firms could leverage knowledge acquisition rather than just from simple knowledge contents, as knowledge is also about context-based characteristics (Lee and Choi 2003). In sum, the context-specific knowledge in the firms is significant to its main activity. This knowledge type is relatable to different areas that are significant to the achievement of knowledge activities ranging from knowledge relating to firm strategies and goals to knowledge regarding individuals, processes, assets and the technologies in the firm.

Therefore, the SC knowledge role, SCM knowledge acquisition and the type of knowledge within SCM need to be identified. Added to this, knowledge acquisition has been evidenced to enhance the firm's capability to reuse knowledge although the way right knowledge can be obtained in a timely manner is still unclear. The knowledge

technology strategies are deemed to be crucial in light of their facilitation of KA and the determination of the knowledge resources and capabilities (Liao et al. 2009). Despite the prior studies, evidence of KA as a major key to enhance supply chain management (e.g (Sun 2008; Ma and Nie 2009; Xiaodong et al. 2009)) expanding extant studies to the supply chain topic by applying various perspectives could further enrich literature. In this background, the KA mechanisms that enable enhanced innovation performance could potentially enable enhanced supply chain performance, but in this case, the KA interpretation and its development and application to SC to achieve successful business results is still ambiguous. Along a similar importance, various types of knowledge may have different implications to KA, and as such, deeper attention has to be directed to this fact by further studies. It is pertinent for scholars to propose a technology to allow the direct encapsulation of knowledge, and the expert to structure and contextualize the supply chain knowledge in order to support the implementation of knowledge management within supply chain. This can enable supply chains to leverage benefits from best practices, establish continuous supply chain learning, integrate operations and ultimately, develop a competitive strategy (López et al. 2012).

Knowledge acquisition by organizations or individuals is deemed to be significant to successful organizational performance in a business environment rife with uncertainty and risks. In the supply chain, knowledge acquisition is considered to be of significant advantage to the activities and processes within the supply chain. However, although data, information, knowledge and knowledge sharing are importance to a successful supply chain, studies that examine how to acquire knowledge are still limited (Afolayan et al. 2016). The importance of knowledge acquisition for successful management of supply chain was examined by Afolayan et al. (2016) and he found that supply chain managers have to be active acquisitors of knowledge in order to become potential sources of competitive advantage otherwise they will remain passive data and information recipients. According to the authors, in order to enhance the performance of supply chain management, managers have to engage actively in the process of knowledge acquisition.

Liao and Barnes (2015) looked into the role of knowledge acquisition in the creation of product innovation feasibility (PIF) among SMEs and found that supply

chain managers have to understand information management throughout boundaries as this affects their achievement of a versatile production innovation. He found that an effective external knowledge acquisition (KA) process transforms high-quality supplier relationship. His study was limited to one knowledge management process namely, knowledge acquisition. The author recommended further studies to examine the role of IC on PIF and further empirical studies to determine contingency factors external to and internal to the firm. Table 2.1 shows the related researches of Knowledge acquisition in supply chain management.

Table 2.1 Related study of Knowledge acquistion in supply chain management

Research/Author	Problem	Objective	Technique	Arguments
Study on Supply Chain Oriented Knowledge Acquisition, Sharing and Utilization (Jie and Shuangyi 2006).	Knowledge is difficult to be shared throughout the chain and as such, the function of every joint enterprise remains ambiguous. This generates a poor innovation ability of the SCM.	To develop hypotheses and propose a framework.	Theoretical	There is a need for the knowledge system to develop a knowledge sharing platform. Such a system should have its basis on a repository for storing and classifying knowledge owned by the supply chain.
The Ontology Driven Approach to Vegetable Supply Chain Knowledge Acquisition System (Sun 2008).	The compliance with the user's retrieval habits, and overcoming lack of intelligence in traditional keywords retrieval that leads to unsatisfied outcomes specifically in the case of large database information.	Resolving unsatisfied retrieval outcomes, especially when faced with considerable database information.	Ontology	The reduction of risks faced during knowledge acquisition.
A Study on Risk of Knowledge Management for the Supply Chain in Mergers and Acquisitions: An Empirical Analysis in Yangtze River Delta of China (Ma and Nie 2009)	Scarcity of qualitative and quantitative studies and frameworks representing knowledge acquisition risks and supply chain management in the context of corporate risk management.	Create and propose a knowledge acquisition and supply chain management framework for the supply chain.	Case study	Such practice could guide the practical integration of risk management in the supply chain knowledge management in the case of mergers and acquisitions.
Building Competitive Advantage of Small and Medium Sized Enterprises through Knowledge Acquisition and Sharing (Diugwu 2011)	Studies in literature concerning how SMEs limitations of resources can be resolved through the acquisition of knowledge to build their competitive advantage and sustainability are still few and far between.	Examine the factors that influence knowledge acquisition..	Model	A need exists to determine the feasibility of the way partnering and networking can enhance the competitive advantage of organizations via empirical studies.

to be continued...

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Knowledge acquisition and product innovation flexibility in SMEs (Liao et al. 2009)	There is a need for more empirical studies to determine contingency factors external to and internal to the firm.	Examine the knowledge acquisition role in the creation of product innovation flexibility (PIF) among SMEs.	Model	The findings shed light on how supply chain managers can understand managing information throughout boundaries and its impact on achieving versatile production innovation. External KA process that is effective can transform high quality supplier relationship.
Why knowledge acquisition is important to effective supply chain management: the role of supply chain managers 'as knowledge acquisitors (Afolayan et al. 2016).	Although data, information, knowledge and knowledge sharing are all crucial for successful supply chain, studies that explore knowledge acquisition are still scarce.	To examine the importance of knowledge acquisition to establish successful and effective supply chain management.	Model	In order to enhance supply chain management performance, managers have to engage activity in knowledge acquisition processes.

According to studies in literature, there are several ways to conduct KA in firms; for instance, they might do thus through their suppliers toward utilizing benchmarking, collaborative, and mutual problems-solving as evidenced by He et al. (2013), strategic alliance/ technological assistance as revealed by Zhang et al. (2010), supplier contribution to product development as in Najafi Tavani et al. (2013), informal networking as reported by Lee et al. (2011) and from previous information and current ones gathered from the social surroundings and from collaboration. Studies also found the need for knowledge acquisition, action learning involving problem-solving, concentration on required learning, and implementation of solutions for knowledge generation. Several types of knowledge can be acquired by the firm in this regard like the company experiences, systematic assessment, flow of ideas, challenges, shifting and documenting lessons learned. KA is therefore a complex and interconnected process and emphasis should be placed on the nature of social and interconnection in the phenomenon, particularly when it comes to product innovation. Furthermore, there is a dire need to capture human expert knowledge as well as knowledge held by supply chain partners.

2.6 KNOWLEDGE ACQUISITION IN FOOD MANUFACTURING FIRMS

The industries' knowledge and competencies that lie external to the boundary of food sector are increasingly developing momentum and supporting innovation in the food sector (Carraresi and Bröring 2016). Owing to the strategic role of external resources, knowledge acquisition regarding suppliers and the general supply market is significant and it is a challenging task faced by the firm's purchasing and supply management. The challenge is compounded by the performance-improvement-oriented application of external supply knowledge. Therefore, for the purpose of its examination, Kilpi et al. (2017) drew on the knowledge-based view to develop a study model wherein supply chain acquisition directs purchasing and supply management examination and orientation leveraging, which in turn, had a mediating effect on the organizational purchasing status and supply management function relationship in light of supply performance. They conducted a test on the Small and Medium-sized Enterprises (SMEs)- focused and survey-based dataset model through the use of Structural Equation Modeling (SEM). They found exploitative orientation to be related with knowledge acquired from the supply base, and explorative orientation to be related with supply market knowledge and with supply base knowledge, albeit with relative strength, indicating natural pairings. The findings revealed the way exploitative development orientation had a mediating role on the positive relationship between purchasing and supply management, and supply performance. In relation to this, directed by supply base knowledge, a status-empowered exploitative purchasing and supply management orientation may be used to mitigate supply market based explorative orientation in SMEs that lack resources. Hence, this serves to form the only path to supply performance. The study's contribution lies in stressing the significance of knowledge-resource and knowledge-based view in shedding light on purchasing and supply management performance.

In the context of the food sector, Carraresi and Bröring (2016) examined the drivers of cross-industry innovation in two ways; 1) examining the level to which external knowledge sourcing affects innovation and 2) understanding the level to which various external knowledge sourcing might vary based on the size of the company. In this regard, probit models were used to run a sample of 703 Italian food firms from 2010

to 2012 and according to the empirical findings, the Italian food industry innovation largely hinges on various external knowledge sources. Also, the machinery and equipment acquisition enables food firms to relay external knowledge within the boundaries of the firm. Meanwhile, product innovation leverages advantages from external R& D activities and information garnered from competitors and consultants, while process innovation depends on acquiring technology (machinery and equipment) and information from input suppliers.

Wiegand et al. (2012) study, provided an overview of the NLP effectiveness in the food domain by identifying two potential instances; advice on meals preparation and health related issues dominating food domain researchers when it comes to artificial intelligence. The findings showed that these instances are quite appropriate for NLP techniques. As a knowledge extraction source, they provided an overview of the social media benefits and provided a discussion of the various extraction models that range from co-occurrence measures to complex linguistic analyses. They also touched upon potential issues caused by NLP methods on the proposed tasks.

Furthermore, a framework of open innovation was proposed by Acosta et al. (2013), addressing the key issues linked to external knowledge acquisition in food technology and these include knowledge sources for patented food technology, types of scientific and technological knowledge. The approach depended on patents to measure new knowledge generation, and patent citations to measure external knowledge acquisition towards food technology innovation. The primary findings showed different patterns of knowledge acquisition based on the sector and significant differences throughout countries. Additionally, data showed relatively few differences in knowledge acquisition patterns between large firms (with large capacity to develop patented technologies) and small firms.

Meanwhile, Peng et al. (2014) revealed that the food processing information system is ineffective owing to the lack of knowledge acquisition and a self-updating function of knowledge. They brought forward a knowledge acquisition method based on Support Vector Machine (SVM), where initially, the approach laid down a set of predicted samples for the relationship between food processing parameters and product

quality and second, it utilizes discretization of the ongoing attributes, attributes reduction and a rule extraction algorithm of SVM for the automatic acquisition of predicted knowledge from a considerable sets of predicted sample. This is followed by the saving and storage of predicted knowledge within the expert system's knowledge base. The method brings about knowledge extraction of the food processing process on the basis of the inference engine, enhancing the efficient and applicable element of acquired knowledge in an automated online-assisted decision system of quality and safe food processing.

The literature review highlights that a few studies have examined the knowledge acquisition in the food manufacturing firm, and the potential opportunities for automatic knowledge acquisition according to food manufacturing case study has been ignored. Previous studies highlighted that the information system in food processing is poor due to the absence of knowledge acquisition and updating knowledge.

2.7 ARTIFICIAL INTELLIGENCE IN KNOWLEDGE ACQUISITION OF SUPPLY CHAIN MANAGEMENT

On the basis of the discussion concerning the importance of knowledge acquisition in the SC, it is now evident that a firm in a supply chain has to acquire knowledge to enhance collaboration with other members of the chain. Accordingly, Jie and Shuangyi (2006) study focused on the supply chain oriented knowledge acquisition, sharing and utilization having in mind the following theoretical perspectives on knowledge issues; knowledge is not easily shared throughout chains, each work function in the single joint enterprise is ambiguous, and SCM has poor innovation ability. They addressed the issues and argued the need for the knowledge system platform to promote sharing of knowledge. Such system would be based on a repository that stores and categorizes the knowledge in the supply chain. They called for more studies to pitch in for the system conception and for the tackling of issues like the knowledge sharing culture and system safety prior to system establishment. In this background, studies that have been dedicated to examining automated knowledge acquisition in the SCM are still few and far between, and majority of studies of this caliber stressed on the scarcity of technical

applications (e.g (Sun 2008; Ma and Nie 2009; Xiaodong et al. 2009)). In particular, Sun (2008) examined the vegetable supply chain knowledge acquisition and stressed their application on the unsatisfactory retrieval outcome in different situations of database information. On the basis of ontology, the application devolved and was adjusted to align with the retrieval habits of the user and the timing, in order to tackle the lack of intelligence within the traditional keywords retrieval. The researcher urged further studies to determine ways to mitigate the knowledge acquisition risks.

Added to the above, Xiaodong et al. (2009) looked into the representational ambiguities, the attributed description and the similar measures of knowledge in product design. They developed a fuzzy case-based reasoning (FCBR) in product style extraction with the assistance of linguistic variables after which, the product was encoded by a vector consisting of many attributes, and the product morphology was developed. More importantly, their proposed product style extraction model was created, as mentioned, through the FCBR system, and the result was normalized through Fuzzy Sets. On the basis of their findings, the FCBR model was validated in its effectiveness compared to other product form style extraction models.

Similarly, to this (Ma and Nie 2009) provided a brief outline of the qualitative and quantitative studies that were conducted on the knowledge acquisition topic in supply chain. They found rarity of studies that developed a knowledge acquisition framework and its management within the supply chain context. They also found scarcity of qualitative and quantitative studies in this caliber. Although the importance of knowledge acquisition has been acknowledged to be important for the supply chain, researches and studies to this end are still in their infancy. Prior studies on knowledge acquisition in the supply chain have largely focused on the knowledge transference and sharing issues like ambiguity, optimization, reduction of risks, among others.

The literature review also highlights that no study has yet examined the automation of knowledge acquisition in the supply chain, and the potential opportunities for automatic knowledge acquisition according to SCM case study has been ignored. In sum, the development of export systems, industrial and infrastructure projects have made the supply chain vulnerable to the many different settings that are rife with ideas flow,

challenges and experiences that could be leveraged by the firm to learn and obtain new capabilities from. This research managed to review a literature and findings upon which lessons can be drawn from. The problems with sustainable solutions indicate the dire need to develop an infrastructure coupled with supply chain environment. This calls for a commitment of the firm to learn from prior knowledge, knowledge acquisition, knowledge sharing, and lessons application to future projects. In fact, the opportunities for learning, knowledge sharing and innovations that stem from the projects can improve knowledge obtained from the supply chain of firms, and this can ultimately lead to enhanced knowledge and performance of the firm.

2.8 CASE-BASED REASONING

CBR is described as a problem-solving paradigm that depends on case representation, rather than on general knowledge regarding the problem under examination. Moreover, case representation in a CBR system covers a detailed description of the problem with the corresponding detailed description of its solution. In a case representation, majority of the data is storable within a specific case; for instance, stored data in a relational database, photographs, sound and video can be brought forward in a certain case. It may however be challenging to represent a considerable amount of interconnected data of a case and as such, information functionality and acquisition has to be first clarified prior to deciding which of them should be brought forwarded. In a related study, (Watson 2001) demonstrated the important information in a case with the help of two pragmatic measures namely, functionality of information and the ease of information acquisition. In this background, CBR depends on the structure and collected case in the repository of the case and thus, it is crucial to possess an organizing mechanism that enables the retrieval of the required information at a timely manner. It is also crucial for case representation to have a mechanism that is standardized in its support, suitability and appropriateness to reinforce the retrieval of the case. The CBR cycle has four phases, which are retrieve, reuse, review and retain. Figure 2.4illustrate the CBR phases.

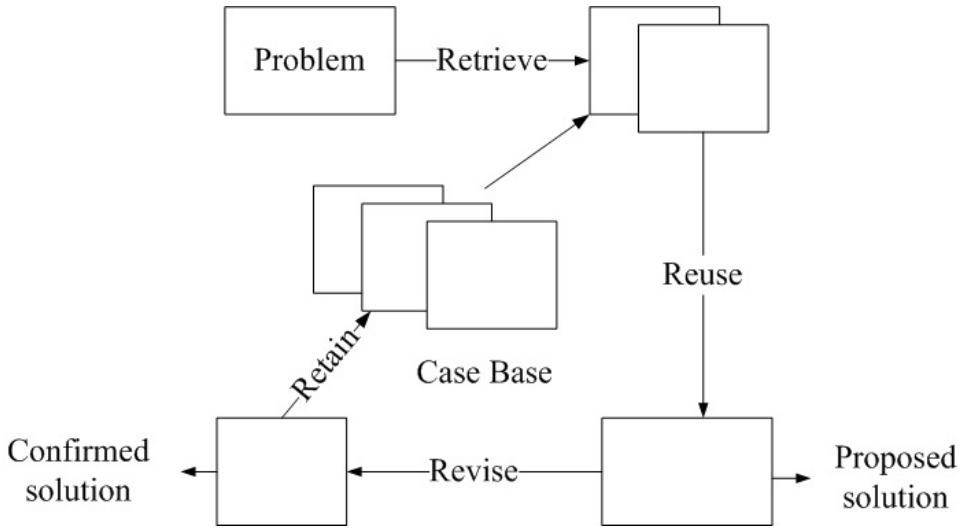

Figure 2.4 The CBR cycle

Source: (Watson 2001)

2.8.1 Case-Based Reasoning Phases

This section describes the CBR processing.

i) Retrieval phase

The retrieval phase is to decide which case in the case repository is similar to a target case (target case is the current problem to be solved). When the case that is the most similar to the target case is found, then the CBR system retrieves the matched case that can provide a detailed solved problem description to the problem. The two most widely used techniques of case retrieval are: nearest-neighbor retrieval and inductive retrieval. Nearest-neighbor retrieval is a technique used to measure how similar the target case is to a source case (Watson 2001). It processes retrieval of cases by using the comparison approach of a collection of weighted attributes in the target case to source cases in the CBR library. If there is no matched case in the CBR library, CBR system will return the nearest-matched source case. The return of the nearest-matched case can be

found using the following equations (Watson 2001):

$$sim(x_i, y_i) = \begin{cases} 1 & \text{for } x_i = y_i \\ 0 & \text{otherwise} \end{cases} \tag{2.1}$$

$$sim(x_i, y_i) = \begin{cases} 1 & \text{if } x_i \leq y_i \\ 1 - \frac{|x_i - y_i|}{|max(x_i, y_i)|} & \text{otherwise} \end{cases} \tag{2.2}$$

$$sim(x_i, y_i) = \frac{\sum_{i=1}^{n} w_i * sim(x_i, y_i)}{\sum_{i=1}^{n} w_i} \tag{2.3}$$

where:

- n is the number of attributes of a case.

- $x_i$are the attributes of new case.

$-$ y_i are the attributes in the case base.

$-$ $sim(x_i, y_i)$ are the different attributes similarities between$x_i$andy_i.

$-$ w_i are the weights,$w_i \epsilon [0, 1]$.

The equation of the nearest neighbor retrieval technique represents the sum of similarity of the target case to the source case for all attributes multiplied by the importance weighting of individual attributes. The CBR system retrieves a meaningful case that may provide a detailed solved problem description to a new problem. However, the nearest neighbor retrieval technique is not efficient. This is because whenever new cases are introduced, indexing needs to be performed and this could affect efficiency (Watson 2001).

ii) Reuse phase

In the reuse phase, the solution from the retrieved case is used to solve the target case. In general, reusable case is more user-acceptable because its solution has already been accepted and convinced by the previous user. At the reuse phase, the solution from the matched case can be used without modification, or adaptation may be applied to adapt the solution to match the new problem (Watson 2001).

iii) Revise phase

In the revise phase, the solution needs to be verified and evaluated to match the

correctness of the solution. Once the verification is completed, the target case with its solution will be retained in the case memory (Watson 2001).

iv) Retain phase

This is the retain phase of the CBR cycle. Indexing is commonly used in the case retainment phase in CBR. It allows retrieval of cases to be optimised. However, it is important that indexing be provided at an appropriate level of generality in terms of global and local context, so that it reflects the hierarchical structure of cases (Watson 2001).

In summary, when the new problem issue arises, the retrieval process identifies the problem as a case to find out the most similar one in the past cases. Then, if there is any matched one in the past cases, it will be presented as a solution of new case. If it is necessary, adaptation occurs and a new case is created.

2.8.2 Case-Based Reasoning Applications

Mansar et al. (2003) examined the potential of CBR from Knowledge management perspective, especially in reducing the lack actual guidance on deriving a process design threatening the success of BPR. This study develops a technique that would allow practitioners (consultants and senior managers in enterprises) to access previous redesign projects and, possibly, reapply some of the best findings. The result has demonstrated through knowledge acquisition and knowledge representation that applying CBR is possible for BPR implementation and would benefit from (re) designers in the following way: Knowing the current process and knowing the problems those need to be addressed, similar processes with similar problems might be retrieved to find out which best practices have been applied and which technical and organizational solutions were adopted. Another situation might be that the consultant has already an idea about some rules he wishes to apply, but he is not sure about the impact of applying them, or he wants ideas about possible adopted solutions. CBR can help in finding a similar business process, with a similar problem and similar applied rules.

Kwon et al. (2007) adopted the characteristic of CBR and multi-agent to enhance the coordinating and sharing information in the presence of various supply and to solve the demand uncertainties . They demonstrated the combination of CBR and multi-agent based coordination mechanisms in order to improve the produce the optimal results for the supply chain instead of using CBR alone.

Fang and Wong (2010) have integrated the intelligent Agent with CBR. Intelligent agent is used to interact to exchange bargaining offers. CBR is applied in order to efficiently retrieve the suitable case from the case based. The proposed hybrid approach reuses the previous successful case to solve a new problem an enterprise encountered with. As well as it provides some effective adaptation algorithms to make this case suitable for the new negotiation situation.

Garg et al. (2011) proposed an integrated framework based on multi-agent collaboration and case-based reasoning process of CBR. The approach which is MACESCM system is used to provide more flexible and extensible solution to help address emerging uncertainties in Supply Chain Management and build a complete comprehensive multi agent system to understand, manage and make informed decision to minimize disruption in SCM.

Fu and Fu (2012) investigated the use of a combination of the CBR and Multi-Agents. Their approach is used to solve the complexity cost of inter-organization management in supply chains. Their study indicates that this approach is being able to better improve the competitive capacity and to solve some current problems in the cost management of supply chain.

A series of studies exist in literature that are dedicated to automate supply chain through CBR, and in this background, case-based reasoning is among the top fields in AI, where it automates human thinking. In this regard, Douglas Adams related that human beings are the most distinct beings that have the ability to learn from experience of others, and they are remarkable for their evident disinclination to do so. In other words, experience is a valuable fact that can be useful in many ways. There are several actual examples from professions within which problems can be solved through prior experi-

ences (physicians, financial consultants and drilling engineers). In fact, the modulation of human reasoning calls for laying stress on the use of prior experiences (Dalal and Athavale 2015).

Case-based reasoning method was also employed by Fang and Wong (2010) in the pre- and past-negotiation stage to facilitate adaptive negotiation strategy for the negotiations between buyers and sellers in SCM. The major problem with such models is its unsuitability in dynamic SCM concessions. Therefore, in Faez et al. (2009) study, he combined integer programming, fuzzy set theories and CBR for the purpose of supplier selection and considered fuzzy parameters in an mixed integer programming model. Meanwhile, Zhao and Yu (2011) made use of the CBR approach to develop auto-immunization knowledge acquisition level geared towards enhancing system performance and expediting the period of exploration of the intelligent system. The model's shortcoming lies in its complex nature, for instance, with the increase of number of cases, the efficiency of decision-making quickly takes a dip (Wu and Barnes 2011).

A supply chain disruption management framework was proposed by Giannakis and Louis (2011) to deal with the amelioration of abnormalities in the manufacturing SCs. The study framework integrated case-based reasoning, where prior decisions were utilized for current decision making –this was directed towards allowing the learning capability of the agent while taking the integration issues into consideration in order to employ an add-on module to legacy systems. In a related study, (Fu and Fu 2013) demonstrated a novel supply chain method that combined four collaborative cost management (CCM) steps and CBR procedures with fuzzy inference model. The method managed to enhance the traditional similarity assessment and garnered the top optimum case for solving new issues. The study provided a new definition of information set on the CCM problem and laid stress on CBR self-learning for CCM to ensure that the chosen case solution is the top suitable solution and to achieve the CCM's collaborative effect value.

Aside from the above studies, Dey et al. (2015) brought forward a real-life case-based action study through the integration of analytical model combining quality function deployment and analytic hierarchy process method to evaluate suppliers' perfor-

mance. The method's effectiveness was illustrated through several validation processes including focus groups, business results and statistical analysis. The study found that improved supplier performance outcomes have a positive influence on the performance of client organizations in terms of operations and business.

In another related study, (Jahani et al. 2015) proposed a method integrating three supporting perspectives namely, multi-agent systems, fuzzy logic and case-based reasoning. The perspectives have rarely been combined together in one framework in literature. The exploratory case study was focused on an office furniture company to demonstrate the framework's value. The proposed agent-based framework conducted an evaluation of the supply offers on the basis of the preferences of customers. It produces alternative products in stock-out cases, and facilitates a collaborative environment among agents representing various supply chain entities. In particular, the proposed fuzz case-based reasoning (F-CBR) approach managed to minimize the information overload by systematically organizing them into cases – this led to less overall search between cases. According to the author, unsatisfied customers, information overload and high uncertainty are the top challenges in the supply chains presently. However, their proposed system excluded functions of inventory management and agents negotiations. Also, the case description and case retrieval phases of the case-based reasoning approach were examined to the exclusion of the other phases (e.g., case retaining, case reusing, and case revising phases).

Finally, Dalal and Athavale (2015) brought forward a case-based supply chain strategy analysis model that produces cases oriented on different factors entailed in the SC process performance evaluation. The model was designed in Java language with a platform characterized by independent, secure, robust, object-oriented features. The author implemented K-Nearest Neighbor algorithms to determine similar cases from the case repository. The model calculates performance strategy of the SCMS but its drawback is its inefficient accessibility of K-NN algorithms to retrieve similar cases from the repository. With the increase in the number of cases and in the size of case base, the system slows down.

Based on the the previous studies, the researcher noted that there are many stud-

ies that use CBR in SCM and knowledge management, due to the many advantages of CBR that can be summarized as:

- The ability to facilitate adaptive negotiation strategy for the negotiations between buyers and sellers in SCM.
- Enhance the traditional similarity assessment and garnered the top optimum case for solving new issues.
- Allowing the learning capability of the agent while taking the integration issues into consideration in order to employ an add-on module to legacy systems.
- Deal with the amelioration of abnormalities in the manufacturing SCs.
- Enhancing auto-immunization knowledge acquisition performance and expediting the period of exploration of the intelligent system.
- Ensure that the chosen case solution is the top suitable solution for achieve the SCM value.
- Produces alternative cases, and facilitates a collaborative environment among agents representing various supply chain entities.
- Extensive analysis of domain knowledge is not required.
- Minimize the information overload by systematically organizing them into cases – this led to less overall search between cases.

2.9 INTELLIGENT AGENT

The relatively new emergence of supply chain knowledge management is one area of AI's potential application and this calls for the understanding of complex, interconnected decision-making processes and the development of intelligent knowledge bases for joint problem-solving procedures (Min 2010). A series of studies were dedicated to automate supply chain using agent-based models that highlighted the linkage between AI techniques and supply chain performance. Hence, AI techniques have a crucial role and based on them, other methods can be highlighted to improving SC Performance.

Hassan and Soh (2005) had examined the potential of IA from SCM perspective, especially in supply chains web service. Traditional Supply Chain architecture is less

agile and is unable to configure automatically due to ever changing business environment or business needs. they developed Intelligent agent framework that can be used to deal with dynamic and adaptive supply chain integration in a web-based environment.

Xin et al. (2006b) adopted the characteristic of IA to enhance the corporate management in maintaining a competitive edge by building strong relationship with employees, customers and suppliers. They demonstrated that agent technology is the best choice to address KM in the context of e-commerce.

Labarthe et al. (2007) studied stemmed from the need for define new tools for the design and management of complex mass customizing supply chains. They had proposed an agent modeling framework for the modeling and simulation of such Supply Chains to facilitate their management. The framework can be applied to a case of customer-centric Supply Chain from the golf club industry and they presented an experiment plan associated.

Zhang et al. (2007) investigated the use of Multi-Agents on knowledge management in supply chain. This approach is used to solve the buyers and sellers information overload in online buying process. The difficulties and complexity of KM in SCM are argued based on complexity theory and complex adaptive system theory. They proposed a conceptual system framework based on multi agent system. The study indicated that this approach is synthetically epistemology and multi dimension methodology.

Mogos and Socoll (2008) examined the use of IA on knowledge management in e-business Environment. The approach is used to solve the complexity of the knowledge sharing in SCM. The study indicated that the result of applying intelligent agent technology to knowledge management in e-business shows the efficiency and effectiveness. With the relevant knowledge embedded in buyers and sellers, the intelligent agents' system help buyers and sellers cope with information overload and expedite the stages of the on-line buying process.

Min and Yu (2008) proposed an agent-based forecasting system to synchronize a series of interconnected stages of joint demand planning and forecasting process in the SC. Such system was capable of predicting end customer demand based on infor-

mation exchange among SC partners and prior forecasting experience. Also, some sub-categories of AI like expert systems and agent-based systems are effective in tackling different aspects of SC like warehousing, joint demand planning, and inventory control. In a related study, Wu et al. (2013) looked into retail stock outs by developing an agent-based simulation model to shed light on the influence of various stock out lengths in different products having different consumer response profiles to stock outs) on retailer as well as manufacturer. They deemed the market change as the measure of versatility of manufacturer and retailer in examining the influence of stock outs and this provided insights into the response of both stakeholders to the stock out disturbance.

An integrated framework for agent was proposed by Long and Zhang (2014) on the basis of inventory-production-transportation model and the supply chain simulation. The model comprised of four levels ranging from domain modeling to multi-agent systems implementation and it considered the agent-based modeling and distribution simulation theory, four-layered conceptual agent model, a meta-agent class library and a multi-agent based distributed simulation platform. The framework was geared towards providing users with a meta-agent class library and meta-agent based distributed platform for SC upon which the agent-based simulation can be visually and rapidly developed, with meta-agents as building blocks. The framework also promotes independent building of sub-simulation models by their implementation and synchronization in a distributed environment. According to the authors, the proposed integrated framework is flexible in multiple layers, multiple granularities and scalabilities.

In a similar line of study, Medini and Rabénasolo (2014) conducted an analysis of the performance of supply chains with the help of agent-based simulation based on the SC operations reference model. More often than not, indicators and negotiation mechanisms in an SC are primarily developed for local management on a one-to-one relationship. The study provided the different effects of supply chain configurations and the dynamic environment on SCOR performance indicators based on a global viewpoint. The study introduced a modified version of the traditional SCOR indicator having a priori knowledge of the network connectivity.

An agent-based negotiation model was proposed by Yu and Wong (2015) for the

automation of supplier selection process. The model entailed a series of products having synergy effect and the multi-agent system was used to achieve the proposed negotiation model for multi-product supplier selection. Added to this, the authors elaborated on the negotiation proposal, negotiation protocol, negotiation strategies and the methods of decision making in the negotiation model for the product-supplier selection environment. They expected the model to facilitate purchasing company-supplier agreements on the products details while exploiting the synergy effects among the products. Also, Solano-Vanegas et al. (2015)) proposed an agent-based model of customer-oriented supply networks, focusing on the customer's purchase decision-making process as well as supply network adaptability. The model had its basis on actual case study from the floriculture sector in the context of Columbia.

Furthermore, in Chu et al. (2015) relatively recent study, the author used an agent-based simulation for a multi-leveled inventory optimization problem modeled after a network that comprised plant, distributer and distribution centers. The agent-based model was utilized with a mathematical optimization focusing on more parameters in inventory systems. The inventories were used as buffers against the demand valuation and fluctuations in lead time. The model comprised of a facility agent that monitored and refreshed inventory, an order agent that saved data (demand, sender, receiver, and status) and a shipment agent that recorded data (shipment quantity, shipping time, sender, receiver) and lastly a customer agent that obtains orders based on related probability.

In a study conducted by Mortazavi et al. (2015), the author used a four echelon supply chain consisting of distributer, retailer, manufacturer and supplier, with the inventory quantity analyzed weekly after which orders are placed. In particular, retailers could perform the policy of partial demand satisfaction in modeling, with orders relayed to the distributer weekly. The manufacturing agent produced raw and finished products and consisted of operations that transformed raw materials to finished products. Meanwhile, the suppliers were modeled as an agent, with procurement time. The study employed learning method for instructing agents to learn the way to differentiate circumstances and to choose related actions to heighten the numerical rewards signals in order to achieve maximized strategy. The agents had a choice as to the use of knowledge and the optimum action/actions to adopt to explore new opportunities to improve

policies.

Ge et al. (2015) produced a model based on farmer's behavior by agent-based simulation in the form of agricultural supply chain optimization model. Farmers were considered as smart agents that perform experiments and look at neighboring areas to gather information to adopt behavior based on data gained for the coming period. The authors noted the risk effort factor among farmers, in which case, if the delivery is misrepresented by farmers, they will be charged with a punishment. The penalty system motivates the promotion of efforts for enhanced delivery in a more generalized context. Added to this, agent interaction was modeled through the definition of physical distance between farmers, based on which farmers can share information. In case a farmer in a specified distance has been system tested, then the other farmers would delivery more diligently but if a farmer has not been tested, then the other famers would be lackadaisical in their efforts to provide accurate and valid deliveries.

Based on the the previous studies, the researcher noted that there are many studies that use IA in SCM and knowledge management, due to the many advantages of IA that can be summarized as:

- The ability to synchronize a series of interconnected stages of joint demand planning and forecasting process in the SC.
- The capability of predicting end customer demand based on information exchange among SC partners and prior forecasting experience.
- The efficiency in tackling different aspects of SC like warehousing, joint demand planning, and inventory control.
- Synchronization in a distributed environment, the IA is flexible in multiple layers, multiple granularities and scalabilities.
- Helpful in automation of knowledge management in supply chain.
- Optimization the inventory problem.
- Ability to produced raw and finished data and consisted of operations that transformed raw materials to finished products.

2.10 SUMMARY

In this chapter, the researcher presented a survey of knowledge management system, knowledge acquisition, knowledge acquisition in supply chain management, supply chain knowledge through a review of the relevant literature. The literature review enabled the researcher to provide a detailed discussion on knowledge acquisition and techniques used to facilitate knowledge acquisition in supply chain management. Several different approaches have been mentioned in literature for knowledge acquisition in the supply chain. Studies show that knowledge acquisition in SCM has weaknesses that need to be resolved through techniques that are AI-based. This chapter provided an insight into knowledge acquisition in supply chain management and the studies that provide evidence and support accordingly. The studies showed that CBR and AI techniques can be used to enable new knowledge acquisition, storage and reuse within the supply chain. Such techniques can be used in the supply chain to provide successful knowledge acquisition, enriching knowledge repositories, and decision-supporting mechanisms, and eventually, support knowledge management activities. Knowledge management is a process that involves multiple activities and a CBR system can be integrated to retrieve and adapt to such activities. The combination of CBR and AI can work towards enhancing knowledge acquisition processes by updating new knowledge, facilitating its learning, and adapting to new and old cases. The next chapter contains the presentation and discussion of the proposed study framework.

CHAPTER III

CONCEPTUAL FRAMEWORK

3.1 INTRODUCTION

In chapter two, key issues for the research were identified and discussed. These were: the knowledge management in supply chain management, supply chain knowledge, knowledge acquisition in the supply chain, artificial intelligence application in supply chain knowledge management, artificial intelligence application in knowledge acquisition in supply chain management. A conceptual model is developed based on the literature review and in relation to the research objectives.

A conceptual framework is developed and presented in this chapter. According to Walsham (1995), it is recommended that a researcher embarking on interpretive case studies “create an initial theoretical framework which takes account of previous knowledge”. A conceptual framework lays out the key constructs related to the phenomenon being studied and the presumed relationships among them (Miles and Huberman 1994).

It has been suggested that researchers use a pre-defined structure to set out their expectations while remaining expectations to unanticipated outcomes (Miles and Huberman 1994). This structure, referred to as the conceptual framework, is based on existing theoretical and empirical knowledge. Miles and Huberman (1994) indicate that the conceptual framework " explains, either graphically or in narrative form, the main things to be studied, the key factors, constructs or variables, and the presumed relationships between them ".

This chapter expands on the following issues. First, the theoretical background

underlying the framework is highlighted. Second, research conceptual framework is discussed. Third, the premises underlying the framework are elaborated and the key terms used in the framework are explained. Fourth, the framework is developed and the theoretical and/or empirical underpinnings of each construct are discussed. Finally, concluding remarks on the proposed framework are presented.

3.2 THEORETICAL BACKGROUND

This section presents the theoretical framework that is used to guide data collection, analysis, and interpretation of this study. According to Kilbourn (2006), the theoretical perspective in a research study reflects the researcher's theoretical orientation, which is crucial to interpreting the data in a qualitative study, irrespective of whether it is explicitly or implicitly stated. In other words, theoretical perspectives play a role as the filter for limiting, choosing, collating, and interpreting the data for this study. Therefore, an analytical theoretical framework has been developed, as shown in Figure 3.1. It will also be further explained later.

This section provides a theoretical understanding of supply chain knowledge. It covers the main theoretical background for knowledge in supply chain management of Resource-based View (RBV) from firm level as a source of knowledge, Knowledge based View (KBV) from the knowledge level as a knowledge is the most crucial resource , and Nonaka and Takuchi's model from knowledge creation as a major source of the innovation of the firm . Supply chain knowledge management researchers have long emphasised the importance of applying theories from other disciplines (Done 2011; Marra et al. 2012) in order to provide innovative insights (Barratt et al. 2011) into this emerging field of study (Done 2011). Following a detailed review of the RBV, KBV and Nonaka and Takuchi's model, these three theoretical perspectives were used to explain the resource and process of knowledge and underpin defining supply chain knowledge. Therefore, these theories are considered the main lens in this research.

3.2.1 Resource Based View Theory

The advent of a new perspective on the critical source of sustainable competitive advantage and strategy formulation came in the form of the resource-based view (RBV) (Grant 1996). The theory's origin can be attributed to the pioneering seminal studies of Edith (1959) entitled, "The Theory of the growth of the firm". In his work, Edith (1959) considered the firm as a set of distinct internal resources via which it differentiates itself from its rivals and it maintains its superior performance. This view is supported by Rubin (1973) who also viewed the firm as made up of a bundle of resources. Nevertheless, the legacy of the RBV of firms was established by Wernerfelt (1984) and Porter (1985) studies, where the theory posits that a firm's external position in the industry is largely dependent on its internal substances Wright et al. (2001) represented by a set of abilities and skills (Fitz-enz 2009). The popularity of RBV did not arise until the beginning of the 1990s as more and more studies were dedicated to its examination (e.g., (Prahalad and Hamel 2006; Barney 1991; Grant 1991; Rumelt 1991; Collis and Montgomery 1995; Hamel and Prahalad 2013))

The theory basically delves into the determinants of the out performance of the firm and it posits that the differences in performance among firms lies in individual firm's heterogeneity, which in turn stems from the firm-owned resources. Hence, according to authors (e.g., (Barney 1991; Grant 1991)), the unit of analysis in the theory is the individual firm.

Firm's resources can be categorized as claimed by Wernerfelt (1984) as tangible or intangible resources, where they are integrated into the firm's assets and personnel. The firm's unique internal resources boost its performance against other firms in a particular industry, where such resources are described in strategic management literature as the firm's competitive advantage. In line with this, Edith (1959) revealed that knowledge resource is debatably the most significant intangible resource of the firm, and their effective management contributes to enhanced performance of the firm. Since its citation this claim has been extended and supported by other scholars in strategic management (Alavi and Leidner 2001). In turn, this academic movement introduces a novel perspective known as the knowledge-based perspective. In the next section, a

detailed description of the concept of knowledge-based view theory is provided.

The RBV has been used extensively by SCM researchers (Huo et al. 2016; Yu et al. 2017). In particular, researchers have used RBV to investigate SCM decision making in terms of resource efficiency (Hsiao et al. 2010; Cohen 2016). The benefit of using RBV is that the role of resources in SC is highlighted as a competitive advantage, which allows to identify different types of SC resources and their characteristics, and to explore how different SC resources can be bundled together to achieve SC competitiveness. Recently, it has been recognised that knowledge is the most competitive resource for SC value creation, hence possessing a unique knowledge base in market and marketing knowledge is invaluable in establishing a SC's competitive advantage.

3.2.2 Knowledge Based View Theory

The knowledge-based view posits that firms' existence depend on their provision of institutional capabilities enabling their creation, sharing, exploitation, and protection of knowledge more effectively compared to the limited and expensive legal institutions that are employed in the market (Liebeskind 1996; Grant and Baden-Fuller 2004). In other words, firms refer to social communities wherein disseminated knowledge is changed into economically-useful products/services through the use of higher-order principles of the organization (Kogut and Zander 1992). Firms possess effective mechanisms that boost their generation, integration and application of knowledge into their business activities. It is thus expected that scholars would consider knowledge to be a crucial part in shedding light on firms' existence (Hayek 1988).

The theory asserts that the value of the organization often comes from new knowledge realization, and the way of using, deploying and converting such knowledge (Davenport and Prusak 2000). The KBV supports the premise that acquisition is a specific process of acquiring knowledge from trading partners. Moreover, the access to different knowledge sources facilitates the development of the firm's knowledge base and its connections (Kogut 2000).

In relation to SCM practices, several studies have justified the influence of knowledge in SCM practices. This means, these studies have justified the fact that knowledge to be the source of competitive advantage hence exchange of knowledge increases the supply chain (SC) value creation. For instance, Afolayan et al. (2016) argued the importance of knowledge acquisition for effective supply chain management. Rusly et al. (2015) showed that acquiring relevant knowledge enables the supply chain to obtain critical knowledge to support its survival and competitiveness. Kant and Singh (2011) demonstrated the that supply chains depends mostly on knowledge.

3.2.3 Nonaka and Takuchi's Model

According to Nonaka and Takuchi's model, firms are able to create knowledge by interacting their explicit and tacit knowledge or converting it through four methods namely socialization, externalization, combination and internalization (Nonaka 1994). In this context, prior studies (Spender 1992; Grant 1996; Nonaka 2002) are of the consensus that knowledge management covers two processes, which are acquisition and application of knowledge. Knowledge acquisition is the initial phase of knowledge management.

Nonaka and Takeuchi (1995) provides an insight into the process of knowledge creation – other studies in literature explain the process of knowledge acquisition or sharing; for instance, Tsang (2002) examined the way firms acquire knowledge from international joint ventures through a survey distributed to Singaporean and Hong Kong firms located in China. His findings showed that oversight and management involvement determine knowledge acquisition from the joint venture partners. Simonin (1997) emphasized on the significance of knowledge sharing between strategic alliance partners where collaborative knowledge is obtained by inter-organizational collaboration through the experience of collaborators. As a result, knowledge acquisition leads to fruition in the form of future collaborative advantages.

Meanwhile, in Tsai (2001) study, he looked into the internal sources of knowledge acquisition/creation in an organization by examining the notion that intra-organizational

units are able to learn and acquire knowledge from one another. Such process, according to him, boosts new knowledge development. As a result, new knowledge contributes to the creation of innovation.

Previous studies provide an insight of knowledge acquisition across internal and external supply chain management. Several authors focused on the role of knowledge integration/application in supply chain. Studies in this branch include (Hernes 2016) research where he indicated that the integration of knowledge is necessary in SCM. In addition, Liao and Marsillac (2015); Afolayan et al. (2016) revealed SCM ability to leverage newly acquired knowledge. They explained that following knowledge acquisition, it is important for SCM to analyze the value of new knowledge and effectively disseminate such knowledge and utilize it for companies to overcome problems in managing their supply chains. By doing so, knowledge application effectiveness would increase, and in turn, would facilitate new product development.

3.3 RESEARCH CONCEPTUAL FRAMEWORK

The literature on the five aspects of knowledge management in supply chain management, supply chain knowledge, knowledge acquisition in the supply chain, artificial intelligence application in supply chain knowledge management, artificial intelligence application in knowledge acquisition in supply chain management, considered in this thesis, has suggested several techniques that may enhance knowledge acquisition development. The investigation of these techniques in the context of knowledge acquisition forms the basis for this research. Knowledge acquisition in SCM has been mainly studied from the theoretical perspective. However, from a technical perspective, there is a few applications in prior studies that focused on the knowledge acquisition in SCM. For example, Sun (2008) concentrated on the vegetable supply chain, where the application dealt with the outcomes that fell short of retrieving in the case of extensive database information. The application was developed according to ontology and it attempted to comply with the retrieval habits and timing of users to prevent lack of intelligence issues found in traditional methods of keywords retrieval. He laid stress on the requirement for further studies to examine the minimization of risk in knowledge acquisition. Mean-

while, Xiaodong et al. (2009) brought forward a fuzzy case-based reasoning (FCBR) framework developed in extracting product style with the help of linguistic variables. Despite the efforts of the above mentioned authors, Ma and Nie (2009) indicated the lack of qualitative and quantitative researches dedicated to the scope of knowledge acquisition in supply chain. Moreover, a study has yet to be carried out to develop a knowledge acquisition framework and its supply chain management.

In supply chain management, knowledge acquisition covers various issues and more importantly, a great proportion of the supply chain considers knowledge acquisition in SCM as the most significant characteristic that requires a distinct approach to conducting future technical research. Majority of research have already addressed the automation of a supply chain (Hassan and Soh 2005; Kwon et al. 2007; Fang and Wong 2010; Garg et al. 2011; Fu and Fu 2012) which, although rarely done with automation of knowledge acquisition in SCM literature. Further, existing research has often emphasized the role of knowledge acquisition in the supply chain (Oelze et al. 2014; Cramer 2005). These bodies of literature have suggested that knowledge acquisition is important in of SCM, because it facilitates organizational learning (Oelze et al. 2014). As such, buyers' implementation efforts and suppliers' compliance rates are likely to be positively associated with learning processes, which may include training, audits and site visits (Emmelhainz and Adams 1999; Mani et al. 2015), and the competences developed through the interaction between buyer and supplier (Preiss and Murray 2005; Oelze et al. 2014). López et al. (2006) further argue that creation, acquisition and integration of knowledge aimed at developing the resources and capabilities that allow the organization to achieve better performance. Although it is largely believed that knowledge acquisition can improve a firm's ability to reuse knowledge, this acquisition and its timing is still ambiguous. Strategies of knowledge technology are required to facilitate knowledge acquisition as they identify the manner to which knowledge resources and capabilities have to be utilized. In this regard, the inter-correlation among SC knowledge, classification of knowledge, and system tools with knowledge acquisition arises.

To date, only two studies Sun (2008) and Xiaodong et al. (2009)) have included the automation of knowledge acquisition in their research. As such, this implies a bigger challenge as it entails greater effort in acquiring knowledge manually. This may

divert back to the notion concerning the value of automation in the reduction of effort in knowledge acquisition. As discussed earlier, the objective of the empirical investigation in this study is the development of an appropriate framework for automated knowledge acquisition in the context of supply chain management.

In order to study the automated knowledge acquisition which is required for an supply chain management, a framework is proposed. From a theoretical perspective this study is a contextual analysis, as the intention is to find and understand linkages between: knowledge management, supply chain management, knowledge and techniques associated with knowledge acquisition, and supply chain knowledge , to assess the overall state of an automated knowledge acquisition in supply chain management.

Frameworks such as the theoretical perspective of knowledge characteristics (Hall and Andriani 1998; Smirnov and Chandra 2000; Flscher and Stokic 2002; Meixell et al. 2002; Huang et al. 2003; Nath et al. 2005; Wadhwa and Saxena 2005; Naoum 2007; Zhang et al. 2007; Ge guo and Li 2008; Keqin and Shurong 2008; Zhang et al. 2008; Sezgin and Saatçıoğlu 2011; Deng and Peng 2008; Samuel et al. 2011)and (Wang et al. 2008) suggest that the best of automation of knowledge acquisition attempts in the supply chain should concentrate on identifying relevant knowledge. In this sense, the researcher assume that the modelling of knowledge types is essential step toward development of automated knowledge acquisition in supply chain management. Thus, the link between knowledge types and supply chain management and knowledge acquisition is primarily manifested in the automated knowledge acquisition in supply chain management.

Frameworks such as the technical perspective of knowledge acquisition (Sun 2008; Xiaodong et al. 2009) implored further researchers to explore ways to minimize the risk of knowledge acquisition. In this sense, the researcher assume that the techniques based on the previous researchers namely; cased based reasoning, ontology, intelligent agent and fuzzy logic will contribute and inspire to the development of automated knowledge acquisition in supply chain management. Thus, the link between knowledge acquisition and techniques is a second stage in the automated knowledge acquisition development.

Sun (2008) who proposed an application to solve unsatisfied retrieval results, particularly in the situation of large database information. The application is developed based on ontology and aimed in order to comply with the users' retrieval habits, meantime overcome lack of intelligence in traditional keywords retrieval. For the purposes of this research, we elaborate on this model and include the knowledge modelling of supply chain knowledge and artificial intelligence techniques. In determining what techniques to be applied in this research, the present study relies primarily on the extensive work of Kwon et al. (2007), Fang and Wong (2010),Garg et al. (2011).

3.4 THE CONCEPTUAL FRAMEWORK PREMISES

The current study is built on two premises. Support for each premise from literature has been highlighted in the literature review in Chapter two.

First, the researcher assume, in this research, knowledge types of supply chain management is essential bases to enhance an knowledge acquisition. The knowledge types are categorized based on supply chain function which is planning, production, warehousing, delivering and transportation.

Second, in supply chain management, the knowledge acquired from supply chain partners impact is likely to enhance innovation and creativity (Sambasivan et al. 2009). Hence, it is essential to address knowledge acquisition by combination of two techniques of AI namely:Intelligent Agent (IA) and Case-Based Reasoning (CBR) to reinforce optimal results (Fang and Wong 2010).The study chooses to draw from those applications because they cover both the AI techniques and supply chain management. This is to include automated knowledge acquisition that may enhance acquired knowledge in supply chain management in food manufacturing firm context. This aspect is limited to those techniques that are expected to have an optimal result in acquiring the knowledge in supply chain management and are specific to the knowledge types being studied. When CBR and IA combine, the IA starts with collecting the supply chain partner query through interface agent and then interact with other agents (Acquiring and expert agent) to retrieve the case from data base (cases base). The CBR start with

cases (knowledge) collection from supply chain partners and match the solution for such cases.

The current study focuses on developing automated knowledge acquisition in the supply chain management perspective about the following: supply chain knowledge modelling, knowledge acquisition and combination of cased based reasoning with intelligent agent to get optimal result. In brief, The combination of these two pieces of techniques is incorporated into a prototype processor for acquiring the correct knowledge. Figure 3.1 depicts these premises.

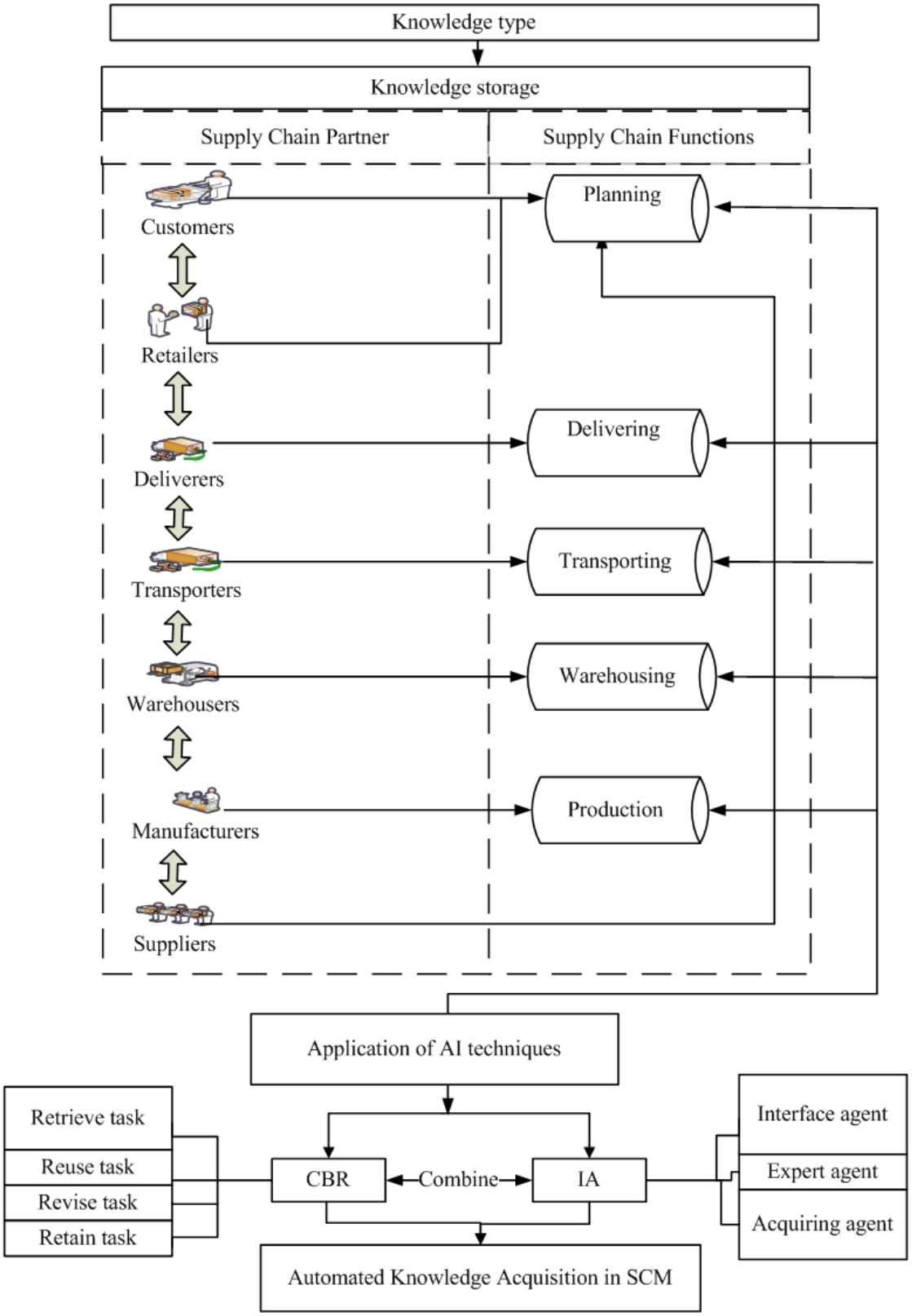

Figure 3.1 Conceptual Framework

This research adopts the following concepts in the conceptual framework that is being proposed:

i *Supply chain knowledge:* In the context of this research the SCK represents the relevant knowledge of the supply chain management environment in a given firm. This is conceptualised by the supply chain partners and its functions which firm can perform to either optimise their knowledge or adapt them to emphasise and achieve knowledge acquisition through appropriate tools.

ii *Knowledge storage:* In the context of this research the knowledge storage represents the modelling supply chain partners knowledge's based on the supply chain functions.

iii *Applied Artificial intelligence techniques:* In the context of this research the combination of AI techniques clarifies the relevant techniques of the artificial intelligence that is proposed by frameworks relevant to the knowledge acquisition, Supply chain management, and knowledge management aspects. For example, combination of intelligent agent with case based reasoning. Such combination may also come in the form of adherence to acquire the right knowledge at critical time.

3.4.1 The Relevant Knowledge of the Supply Chain

The supply chain comprises of the different phases that directly and indirectly contributes to the achievement of the request of customers (Carvalho et al. 2012). Hence, it covers product process beginning from the raw material to delivery of product to the user, the partners that impact the supply chain like manufacturer, supplier, transporters, retailers, customers and warehouses (Chopra and Meindl 2015); this is relate to RBV as the theory claims that firms consists of heterogeneous resources that contribute to the differentiation of the firm from its rivals. All that is relevant to the supply chain has abundant and complex knowledge because of the complex environment and the exchanges that are inter-organizational (Mingxia 2006; Zouaghi 2011). Additionally, the knowledge classification in supply chain management is the basis of the processes that take place in knowledge supply chain management (Sudhindra et al. 2014). Hence, as

listed in the table, prior researchers have attempted to classify knowledge on the basis of their research framework.

Each function of the supply chain management requires different types and function of knowledge (Hafeez et al. 2000). Another essential point, capabilities of generating, interpreting and deploying the multi-source knowledge are key drivers of company success, when responding to the market opportunities (Fugate et al. 2012). Complementary to this from prior researches, this research had explore different types of knowledge that are presented in table 3.1.

Table 3.1 Knowledge Types

Author	Planning	Production	Warehousing	Delivering	Transportation
Smirnov and Chandra (2000)	Business commitment	N/A	N/A	N/A	N/A
Flscher and Stokic (2002)	Process improvements, Process planning, Business process, Technology data, Physical components, Corporate planning, Process model, Technology model, Reduction time, Reduction cost, Experience	Production and maintenance, Production model, Product part, Product design, Shopfloor, Production process	N/A	N/A	N/A
Wadhwa and Saxena (2005)	Decisions, Order planning, Transportation Planning	Production design, Production capacity, Crate product	Inventory planning	N/A	Transportation capacity, Transportation planning
Ge guo and Li (2008)	Customer commitments	Product performance, Product quality, Product safety	N/A	N/A	N/A
(Neumann 2007)	Customer value, Innovation, Superior performance, New capabilities, Formalizing experience, Planning process, Decision making, Problem solving, Learning, Teaching	N/A	N/A	N/A	N/A
Zhang et al. (2007)	Systems, Criterion, Culture, Experience, Intangible, Innovate	Non-secrecy documents about product design	N/A	N/A	N/A
Deng and Peng (2008); Keqin and Shurong (2008)	Customer analysis	Product design, Production Schedule	N/A	N/A	N/A

to be continued...

. . . continuation

Zhang et al. (2008)(Zhang et al. 2008)	Experience, Judgement	N/A	N/A	N/A	N/A
(Zhang and Hong 2009)	Building plans	N/A	N/A	Building demands	N/A
(Done 2011)	Coordinating, Planning, Demand forecast	Production plans	Inventory level	Delivery schedules, Delivery frequencies	N/A
(Samuel et al. 2011)	Logistics provider, Difficulties adapting, Customer demand, Technical situation, Production planning, Sales forecasts	N/A	Inventory reduction	Reliability problems with deliveries	Supplier risk.

Based on the table 3.1, studies grouping was based on SC functions namely planning (Smirnov and Chandra 2000), production (Vishnu et al. 2003; Zagnoli and Pagano 2001; Lin et al. 2002; Higgins 2003), delivery (Zhang and Hong 2009; Done 2011; Samuel et al. 2011), warehousing, and transportation (combined and separately) (Neumann 2007). Specifically, the five categories are explained in detail as;

- Studies classified under planning, primarily concentrated on knowledge relevant to planning which assists management's decision making process. Done (2011), study findings showed that the demand forecasting a vital process affecting not only business profits, but also the amount of waste and the level of customer satisfaction which impact on decision making.
- Under the classification of production, the studies focused on knowledge relevant to production which help manufacturers in improving or maximizing production. Deng and Peng (2008) study findings showed that production schedule it is very important factor in manufacturing process and it has significant impacts on manufacturers decisions.
- Under warehousing category, studies examined knowledge concerning warehousing that assists management in warehousing to improve the inventory case. Samuel et al. (2011) argued that the inventory scheduling is very important part in warehousing department, because it take into account the products that are being inventoried, and establish customized scheduling not only for an entire

business, but also for specific products sold, or manufactured.

- The delivery classification encapsulates studies which focused on knowledge relevant to delivery that assists delivery personnel to develop an optimum method of delivering products to end users.Zhang and Hong (2009) claimed that the delivery scheduling is outbound operation sends from a supplier to a customer about what quantity of a product from a scheduling agreement item is to be delivered at what time.
- Finally, under transportation classification, the studies mainly concentrated on transportation relevant knowledge that assists transporters in enhancing, developing or improving transportation. Wadhwa and Saxena (2005) claimed that the transporting scheduling and capacity is required in the whole production procedures, from manufacturing to delivery to the final consumers and returns.

From the above categories, majority of the researchers focused on knowledge types that relating to planning compared to any other SC functions (Smirnov and Chandra 2000; Flscher and Stokic 2002; Wadhwa and Saxena 2005; Neumann 2007; Zhang et al. 2007; Deng and Peng 2008; Ge guo and Li 2008; Keqin and Shurong 2008; Zhang et al. 2008; Zhang and Hong 2009; Done 2011; Samuel et al. 2011). Therefore, this provided the present research motivation to focus on some other supply chain function other than planning. The knowledge types that are classified based on supply chain functions as mention earlier will be modelled as knowledge base, as shown in figure3.2.

Complementary to this , the design of SCK makes up the first part of the research framework. According to several related studies the best of automation of knowledge acquisition attempts in the SC should concentrate on;

- Identifying relevant knowledge (Wang et al. 2008).
- That is to be recorded, stored and reused for their optimum application advancement (Beatrice et al. 2010);
- That would result in the highest value for the organization (Montaño Arango 2014); and
- That would maximize the overall knowledge of the firm via the help of computer technology (Nemani 2010b).

The major goal in this part is to identify knowledge based on SC functions, which can assist with other parts of the framework to obtain the right knowledge. In the context of this research, SCK is a knowledge that relates to the SC functions which are: planning (Wadhwa and Saxena 2005), production (Flscher and Stokic 2002), warehousing (Samuel et al. 2011), delivery (Samuel et al. 2011; Done 2011) and transportations (Wadhwa and Saxena 2005) as mentioned earlier.

More importantly, knowledge is needed to be modelled and stored in the knowledge base (Rantapuska and Ihanainen 2008). The knowledge modelling applied to actual knowledge acquisition can be invaluable to creating knowledge. Besides, each function in supply chain has its knowledge that helps in the process of making decisions (Hafeez et al. 2000). A knowledge modelling (see Figure 3.2) is created to develop bases of knowledge that assist SC partners to store and retrieve knowledge (Chandra and Tumanyan 2004). In addition, the information and knowledge acquired should be recorded automatically and electronically (Gracia et al. 2007), in order to improve productivity and help knowledge acquisition and accumulation.

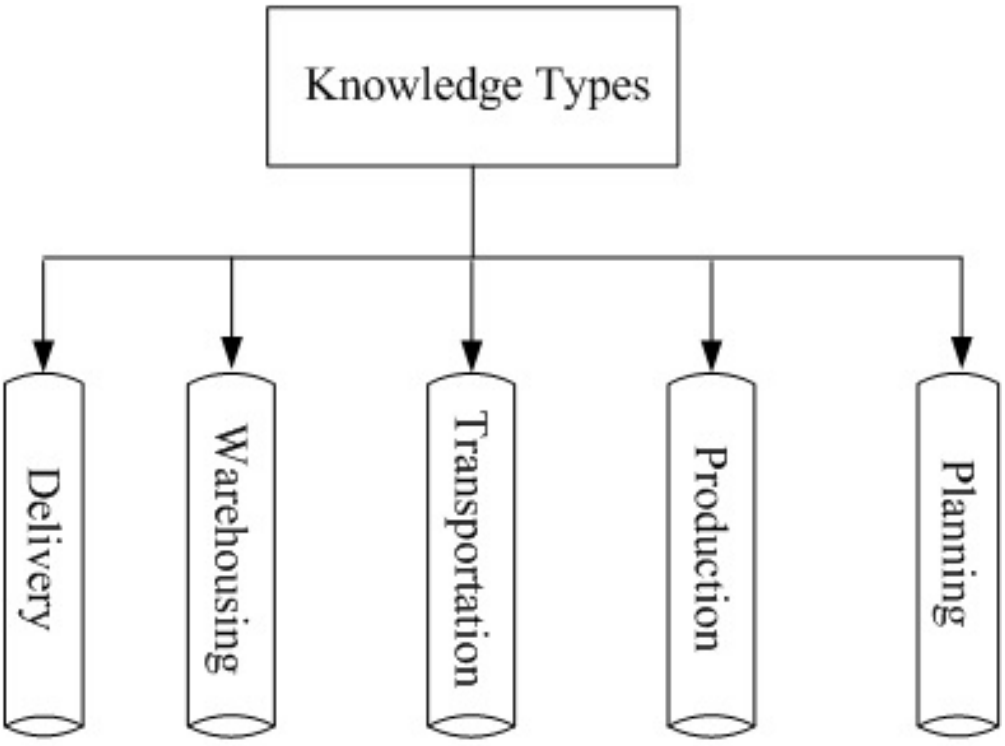

Figure 3.2 Knowledge Modelling

The SC partner must obtain knowledge sources to reinforce their decision making (Ajay and Maharaj 2010). Moreover, to help the partners in reaching a reasonable decision, knowledge acquisition should accumulate and reuse knowledge from prior cases and experts who are capable of providing significant suggestions (Barros et al. 2015). In the decision making process, it is vital to obtain the relevant knowledge on the basis of the type of knowledge. It is considered efficient if the knowledge acquisition method assists the SC partners in their decision making. At the same time, information and knowledge obtained from the decision-making process can be kept in a repository and used by partners and decision makers in their self-learning (Yahia et al. 2012). The method of knowledge acquisition should have functions including; knowledge or cases from the partners that can be submitted electronically (Yu 2009), the submitted knowledge can be categorized in the knowledge base in an automatic manner, and finally, the decision can be generated. In addition, the information and knowledge acquired should be recorded automatically and electronically to improve the productivity and help knowledge acquisition and accumulation.

3.4.2 The Relevant Artificial Intelligence Techniques in Knowledge Acquisition of the Supply Chain

With regards to the importance of AI (Shalini et al. 2017), the most common technique that used for managing supply chain knowledge is IA and CBR (Fu and Fu 2012; Solano-Vanegas et al. 2015). In context of this research, techniques that will be applied to support knowledge acquisition in supply chain management are synthesised based on techniques that applied on supply chain management (Tseng et al. 2013; Solano-Vanegas et al. 2015), supply chain knowledge management (Ahn et al. 2003; Cheung et al. 2012), and knowledge acquisition in supply chain management (Sun 2008; Xiaodong et al. 2009); in order to achieve the study objectives. Two techniques are often employed for effective achievement of supply chain's goals: (1) Intelligent Agent (IA), (2) Case-Based Reasoning (CBR). It is notable that the supporting techniques are evidently linked to enhancing the supply chain performance. Therefore, artificial intelligent techniques have a key role in this context. On the basis of these techniques, varying other techniques can be highlighted to contribute to the SC performance enhancement.

Clearly, the applications adopted for use in the supply chain knowledge management domain were examined by Wu (2001) and he found the software capable of handling the coordination issue among multi-agent systems. The software conducted a summary of many multi-agent systems for KM and provided an overview of the coordination issue in the SC as well as the way multi-agent systems are designed to improve sharing of knowledge and information. In a related study, Zhang et al. (2007) examined the adoption of Multi-agents on KM in the SC to solve the overload of information among buyers and sellers in online businesses. According to him, the integration of KM in SCM has its basis on a complex theory and adaptive system theory. As a consequence, Zhang et al. (2007) brought forward a conceptual framework that is based on the multi-agent system. He showed this approach to be a synthetic epistemology and multi-dimension method. Similarly, (Mogos and Socoll 2008) looked into the adoption of IA in KM in the e-business environment and brought forward an approach to solve the knowledge sharing complexity in SCM. His study showed that the outcome of IA technology application on KM in e-business is efficient and effective, where relevant knowledge is accessible to both buyer and seller groups. The systems help both groups in keeping up with information and in bringing about the online buying stages smoothly.

In addition to the above mentioned studies, Al-Mutawah et al. (2009) laid emphasis on the significance of information and knowledge integration in the SC in the context of manufacturing firms and they provided a discussion of the important aspects of knowledge management. They proposed a study framework based on a multi-agent system to rectify the issues that stem from sharing of tacit knowledge in the firms. Also, Huang and Lin (2010) tackled the knowledge heterogeneity management issue in light of the interoperability among multi-firms using a single supply chain. They brought forward a knowledge sharing platform through semantic web contrary to other studies that concentrated on the Web for sharing information and data. Their platform had its basis on a semi-structured knowledge model that represented knowledge as an explicit, shareable and meaningful format in what is known as an agent-based annotation process. This was proposed to keep away from issues of knowledge heterogeneity. They made use of an articulation method to improve the interoperability effectiveness present in two heterogeneous ontologies.

Fu and Fu (2012) examined the use of a combined system of CBR and Multi-Agents to solve the complexity cost of inter-organizational management throughout supply chains. The study found the approach to be capable of enhancing competitiveness capacity and of addressing issues pertaining to SC cost management. Along a similar line of study, Hassan and Soh (2005) looked into the potential of IA from the perspective of SCM, particularly in the web service and his findings showed that the SC of organizations are rife with several inefficiencies including final higher product costs owing to the inflexible traditional supply chain structure, and the inability to configure automatism on the basis of the dynamic business environment. Also, in Hassan and Soh (2005) study, the author created and proposed an IA framework that was appropriate to tackle dynamic and adaptive supply chain integration in the case of web-based environments. Meanwhile, Xin et al. (2006b) made use of IA characteristics to improve the maintenance of competitiveness by the corporate management through a robust relationship formed with employees, customers and suppliers. Based on the study findings, agent technology is the most suitable choice for KM e-commerce.

In response to the need to define novel tools for designing and managing complex customization of SCs, Labarthe et al. (2007) proposed an agent modelling framework to model and simulate supply chains. The framework was ultimately focused to facilitate management. The study framework was found to be applicable to customer-centered supply chain in the golf club industry and it was suitable to be used as customer simulation.

Two different techniques can be integrated together for knowledge acquisition as evidenced in literature. For example, in Kwon et al. (2007) study, the CBR characteristics and multi-agent were adopted to improve sharing of information, coordinating with the help of suppliers, as well as satisfying demand uncertainties. The study illustrated that the combination of the two enhanced and generated the most positive outcome in the SC. Also, in Fang and Wong (2010), IA was combined with CBR, the former used in exchange for bargaining offers, while the latter is used to efficiently retrieve the appropriate case from the basis. Such hybrid approach was successfully used in a prior case to resolve new issues encountered by the enterprise. It provides algorithms that adapts to the case and the new situation.

Along a similar line of study, (Garg et al. 2011) proposed an integrated framework based on multi-agent collaboration and case-based CBR process, and was referred to as the MACESCM system. The system was employed to solve problems and it is characterized by its flexibility and extensibility that help in tackling uncertainties in SCM and in developing a system to understand, control and decide on the way to minimize disruption. In Kowalski et al. (2013) study, the author explored the application of case-based and ontology-based reasoning in the context of SCM projects to support intelligent reuse of knowledge in the projects. The author also presented and illustrated a recommender system to acquire and re-use knowledge concerning international projects. The projects were based on relevant ontologies integrated in the CBR cycle and the implementation of the recommender system was made possible through the use of open-source CBR development framework.

In the prior section, the significance of knowledge acquisition in the SC was discussed and only two studies focused on automated knowledge acquisition in the SCM (e.g (Sun 2008; Xiaodong et al. 2009)). In the first study, Sun (2008) concentrated on knowledge acquisition in the supply chain of vegetable business. The application sought to rectify the below part retrieval outcome in the different situations of database information. On the basis of the ontology, the application was tweaked to conform to the retrieval habits of the user and to the right timing in order to resolve the absence of intelligence in the keywords of traditional retrieval. He recommended further studies to examine ways to lessen the risk in acquiring knowledge.

Meanwhile, in the second study, Xiaodong et al. (2009) made an attempt to rectify issues in representation, attribute description and similarity measures of knowledge in product design. Accordingly, he utilized a fuzz case-based reasoning (FCBR) in product style extraction by using linguistic variables. Following the encoding of product by a vector that consists of many attributes, he created the product morphology database. The author then developed the product style extraction model with the use of FCBR system and the result was normalized through Fuzzy Sets. On the basis of the results obtained from the experiment, the FCBR model was found to be effective in comparison to other product form style extraction models.

In this study, contrary to other studies, this research deviated from adapting the automation of supply chain to the automation of knowledge acquisition within the SC and instead considered the supply chain functions and partners to it as knowledge sources. In so doing, this research focused on the sources required within the firm for the successful implementation of automated knowledge acquisition in the SC. In this research particularly took the role of AI into consideration in acquiring knowledge and in the process facilitation. This assists in expanding on extant studies (i.e., (Sun 2008; Xiaodong et al. 2009)), and in responding to the recommendations of other authors to include knowledge acquisition in the SC (Cvilikas et al. 2007; Tse et al. 2009; Diaconu et al. 2014).

Complementary to this, based on the suggestion brought forward in the above section of SCK modelling, this part concentrated on the application of AI technologies to suitably reveal the domain knowledge. Because of the many problems associated with using humans as knowledge acquisition agents (Wagner et al. 2003), much of the current research thrust has been directed at developing tools and techniques that can be used to automate the knowledge acquisition process (Cvilikas et al. 2007; Sun 2008; Xiaodong et al. 2009; Tse et al. 2009; Diaconu et al. 2014). Strategies for automating the knowledge acquisition process may range from using high-level expert system shells, which enable an expert to enter his/her knowledge directly into the computer, to programs that interview and prompt the expert (Wagner et al. 2003). Representation the knowledge (e.g expert knowledge) is shown to help the users to reconstruct and apply that knowledge (Khalifa and Shen 2006). According to Khalifa and Shen (2006) demonstrated that the knowledge representation can play in supporting knowledge acquisition and problem solving. Therefore, knowledge representation assists the user in the acquisition of a more sophisticated knowledge structure that enhances the user's application of the acquired knowledge to problem solving.

The knowledge representation is described as an ontological analysis of the expert's thought process and conducting the process logically in a manner that can be programmed by the computer (Yu et al. 2007). It is a transition from knowledge acquisition to set of rules, facts and techniques that can be recorded by computer languages to reinforce electronic and automatic problem solutions. The knowledge representation

strategies include semantic nets, frames, rules, formal logic, decision tables, case based reasoning and decision trees (Yu et al. 2007).

The combination of IA and CBR will solve the complexity issues, managing the knowledge, enhancing the performance and solve uncertainty issues (Hassan and Soh 2005; Kwon et al. 2007; Mogos and Socoll 2008; Fang and Wong 2010; Fu and Fu 2012). Hence, it would be reasonable to employ case based reasoning and intelligent agent to reinforce knowledge acquisition. The combination of IA and CBR, compared to the traditional rule-based system, is more capable to provide problem-solving knowledge, while providing a dependable and ever-expanding knowledge base at the same time to enable the efficient retrieval of knowledge and its reuse for the purpose of making decisions (Bergmann et al. 2004). The IA-CBR combination is also more capable of solving issues related with manufacturing companies like issues of coordination pertaining to the complex business relationships network among the members of the SC, production scheduling pertaining to the priorities of scheduling orders, and product design pertaining to costs and serviceability, among others (Hassan and Soh 2005; Kwon et al. 2007; Mogos and Socoll 2008; Fang and Wong 2010; Fu and Fu 2012). In brief, the combination of these techniques is expected to produce optimal results for automation of knowledge acquisition in supply chain(see figure 3.3).

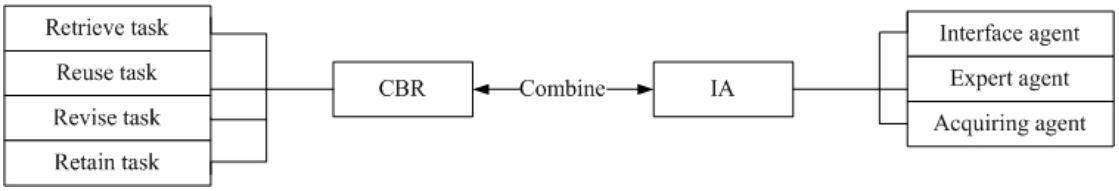

Figure 3.3 Combination of CBR and IA

The purpose of the CBR-IA architecture is to define how the tasks are separated and organised. The agent architecture is designed to carry out distributed tasks separately then combine the results to make a strategic asset allocation decision for the user. The CBR and IA architecture is shown in Figure 3.3.

Each component of the CBR-IA architecture are outlined below:

i. IA component:
    a) Interface agent: The role of interface agent is submitting a case from a user to other agent (Lu and Wang 2008). The interface agent responsible to contact with acquiring agent and expert agent. The interface agent presents solution from the acquiring agent and expert agent.
    b) Acquiring agent: The role of this agent is to acquire the knowledge or solution for the case that got it from interface agent (Li 2008).
    c) Expert agent: The role of this agent is to assist the acquiring agent through the calling the expert to solve such case (Malcomson 2009). The function of expert agent starting when the acquiring agent does not find solution for such case.

ii. The Case Based Reasoning component: The CBR component works with the acquiring agent to keep track of information obtained from various agent architecture parts. It utilizes inferences surrounding inputs that have been previously obtained to identify whether or not information can be reusable, or whether prior problem parts can be repetitively used. The CBR then sends the outcome to the acquiring agent, employing a distinct reference method to guarantee that suitable results are relayed to the corresponding component. The primary aim behind the agent program is to reinforce the activities related with the asset allocation process. Briefly stated, CBR has four tasks namely, retrieving tasks (retrieving similar cases), reusing tasks (to reuse information and knowledge from past cases for determining solutions to problems), revising tasks (to revise problems aligned with prior experiences) and retaining tasks (to retain what could be utilized for future cases). Following this general software program cycle can enable learning from experience. CBR was evidenced to provide the capabilities types that may make it suitable to deal with the strategic asset allocation issues and their related complexities.

3.5 SUMMARY

This chapter has presented research conceptual framework . The details of the proposed framework has been presented and discussed. The main idea of this chapter is a new framework for the automated knowledge acquisition in supply chain management that integrates Supply Chain Knowledge, IA, and CBR. Supply chain knowledge is modelled based on Supply chain functions. In addition, combining the capabilities of intelligent agent and CBR based systems therefore present the opportunity to support knowledge acquisition. By combining these technologies the system could improve and produce the optimal results for the supply chain.

The proposed framework requires further testing for thorough empirical validation. It is the intention that a case study approach which will be discussed in detail in the next chapter. Such a model substantially enhances our understanding of knowledge acquisition. By identifying the relevant types of knowledge that exist in supply chain management , such a framework may also better serve and guide practitioners, managers and those entities in direct contact with the supply chain management successfully and effectively initiating and implementing knowledge acquisition.

CHAPTER IV

RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter discuss methodological issues of research i.e. the philosophy, logic and method of research in order to choose and justify an appropriate research method , to design an analytical process for this study; and to assess the validity and reliability of the chosen research method.

This chapter focuses on presenting research methodology through the introduction of relevant research definitions, concepts and techniques which includes an overview of the methodological framework and philosophical paradigms in general and within the field of information systems in particular, research design and instrument used. The description of the research constructs measurements will be explained. Another important aspect to be considered is the pre-testing of the instruments. This chapter will also include the research approach, case study strategy, empirical research process, data collection strategy, data analysis strategy, population and sampling for the current research, validity and reliability of the current research, and finally the conclusion in the effort to achieve the research objectives .

4.2 METHODOLOGICAL FRAMEWORK

Sarantakos (2005) referred to research methodology as representing the research design and the methods used for to achieve it. The methodology basically provides an explanation of the philosophies that underpin the research methods to explain the valid

connections between the research objectives and the implications obtained from the findings. Ample understanding of distinct critical methodological problems assists in selecting an appropriate methodology to use to carry out the research tasks and logical implications.

4.2.1 Philosophical Position

History contains several philosophical positions that indicate the way scientific research should be carried out (Collis and Hussey 2009). Having said that, philosophical debates have been abounding on the way to conduct IS research (positivism vs. interpretivism) in recent times (von Alan et al. 2004).

Positivism originates from the approach basically used in natural science that can be traced back on realism and it posits that reality does not depend on individuals and that the aim is to develop theories based on empirical research, observations and experiments (Collis and Hussey 2009). Added to this, the positivist theory views reality as a separate entity from the researchers and social researchers as it stresses on their detached role as observers of an objective and singular reality. In this regard, the accuracy and reliability of the research findings are confirmed via statistical testing validity and reliability (Collis and Hussey 2009; Creswell 2013). In other words, positivism refers to social behaviour as an objective fact that is conformable via the running of quantitative tests, whereby such tests provide confirmation that the values, attitudes and biases that distort the objective world would not prevent carrying out an accurate study (Collis and Hussey 2009).

In contrast, interpretivism is based on the principles of idealism (Collis and Hussey 2009) and is underpinned by the premise that social reality is highly subjective rather than objective because the perceptions of people form it (Collis and Hussey 2009). Stated clearly, interpretivism posits that social behavior is a part of the people's minds and as such, it may not be feasible to directly use natural science methods in social science researches. This is because if conclusive inferences regarding subjective human behavior are obtained via empirical methods of data collection in the natural

sciences, this may lead to inaccurate results and findings.

The above discussion of philosophies are considered when examining local issues of research (deductive and inductive positions), with deductive positions focusing on the study wherein the whole research process is directed by theories and assumptions of theories hypothesis form, after which it is empirically tested by specific variables and data, numerically measured against past proposed theories (Collis and Hussey 2009). Hence, in this position, particular cases are deducted from general inferences (Collis and Hussey 2009).

In contrast, inductive research is a study where theory is developed after research data analysis or observation, where general inferences are obtained from certain instances (Collis and Hussey 2009). In comparison, the deductive method frequently entails the philosophy of positivist research unlike inductive method that entails interpretive philosophy.

Juxtaposing to the objectives of the present study, the most suitable philosophical paradigm is the interpretive one as it enables to obtain an insight into the subject matter by searching for subjective meanings assigned to it by participants (Orlikowski and Baroudi 1991; Easterby-Smith et al. 2008). This study is interpretive in nature as this research attempts to shed light on the understanding of the respondents on the knowledge types in the supply chain in the food manufacturing firm. Therefore, adopting an interpretive approach enables to shed light on the richness of the issues linked to knowledge acquisition in the supply chain of the manufacturing firm.

This argument was further explained by Walsham (1993) when he referred to the use of interpretive research in information system to create knowledge, shed information and to discover process indicating the way information system influences, and is influenced by the information system context. Thus, it becomes important to adopt the interpretive paradigm in the present study as it provides an optimum scope for the researcher's interpretation of the issues and the knowledge types considered by interviewees to influence knowledge acquisition in the food manufacturing firms supply chain. Also, in this regard, the interpretive stance according to prior studies (e.g., Or-

likowski and Baroudi (1991); Walsham (1993); Myers and Avison (2002); Oates (2006); Easterby-Smith et al. (2008)) posits that reality is developed among individuals role as social actors.

The one-on-one interview sessions between the researcher and interviewees facilitated the observation of the interviewees' facial expressions, their body language, and they worked towards the establishment of collaboration between the researcher and the interviewees, where field notes were made for extra information to add in the analysis. Through the research method used, it was observed, explored and documented the perceptions of individuals.

Added to the above,Heron (1996) indicated that researchers have to be able to articulate personal values, beliefs and judgments during the research process and not merely when they are selecting the research subject and methods. In relation to this, although the researcher in this study tried his utmost to keep his objectivity, he knows that he can neither be wholly objective nor value-free, and that he has his owns implicit values and therefore, bias remains a possibility. Hence, the researcher tried to keep his interference out of the conversation and to steer the conversation in such a way that his values and judgments do not affect the outcome. For instance, it was noted down personal notes during the research that enabled him to review his role in the research process and to investigate the ways in which is values have influenced the findings interpretations and the process of research.

It is noteworthy to justify that the positivism paradigm is not suitable for the present study, on account of the fact that this study is not based on any existing theory or on hypotheses testing but is based on providing a description and exploring different categories of data to provide insight into the phenomenon. Moreover, the positivist paradigm addresses a singular reality that is contradictory to the present study, the aim of which is to examine the different knowledge types based on various supply chain partners. Subsequent to this, a social research is referred to be categorized on the basis of the research process that illustrates guidelines on the way the research should be carried out and analyzed (Sarantakos 2005). The research process is categorized into two in literature and they are quantitative and qualitative. Detailed discussions of the

adopted approach are provided in the next section.

4.3 RESEARCH DESIGN

The role of research design is to connect the questions to data. Design sits between the two, showing how the research questions will be connected to the data, and the tools and procedures to use in answering them. Research design must follow from the questions and fit them with data. The design is the basic plan for a piece of empirical research, and includes main ideas such as research approach, sample, the tools and procedures to be used for collecting and analysing empirical data (Punch 2000). This research is considered an empirical research, which is exploratory in nature requiring an exploratory research design. The study is empirical as new data or existing data need to be collected and analysed. The study is exploratory as this is a relatively knowledge types and acquiring it in the supply chain of food manufacturing firm. In this section, the research approach and general research sample are described, including the aspects such as tools and procedures used for collecting data, detailed sample determination for the interview survey, the semi-structured interviews, and the case study.

4.3.1 Research Approach

In the qualitative approach, the subjective and inductive position based on the interpretivistic philosophy of research is considered using a versatile design and method characterized by naturalistic data (qualitative data) (Sarantakos 2005). It is based on the notion that social behaviour can be observed through open methods such as observation/interviews with fewer samples compared to the large samples in scientific testing.

Additionally, the qualitative approach does not provide strict generalization basis and it does not call for a considerable sample size to obtain data from. Also, issues may arise as the findings of this type of approach hinges on the subjective opinions and feedback or respondents that may not be generalizable. On the contrary, in the quantitative approach, if the researcher is not suitably knowledgeable of the theories and

key variables, then a research model and hypotheses may not be accurately designed, and the dependent variables may not be operationalized and as such, the findings may not be suitable to test the theory and to provide implications to actual practice (Kelle 2006).

The selection of a suitable methodology to be adopted involves the exploration of the competing paradigms namely positivism (quantitative) and interpretivism (qualitative). It is noteworthy that it is not practical to adopt the quantitative approach for this study's conceptual framework that concerns supply chain knowledge. In Chapter Three, it was mentioned that the conceptualization of the supply chain knowledge, knowledge acquisition and supply functions call for the recognition of the concepts in people's minds that are part of the supply chain, and such concepts are abstract, invisible and socially complex. This can be exemplified by the stages in the supply chain that directly/indirectly fulfill the request of the customer. The supply chain in this case encapsulates the product process from the raw material to the end user delivery, the partners that impact the supply chain (manufacturer, supplier, transporter, warehouse, retailer and customer). Each partner in the supply chain possesses knowledge in abundance and complexity because of the complex environment present in the inter-organizational exchange.

This indicates that the knowledge of the SC partners should not be separated from their thoughts and practices (knowledge/knowledge types). This knowledge will remain elusive until the functions of the supply chain partners are determined. Additionally, the knowledge acquisition studies in the supply chain of manufacturing firms revealed the need to empirically test the knowledge types according to the supply chain functions. This matter is quite complicated to analyze with objectivity and rigor through the use of statistical tools that has yet to be validated.

On the basis of the argument provided above, the qualitative method (interpretivism) is adopted in this study as the approach acknowledges that reality is one with social actors in that it lies deeply within them, and it has subjective attributes. Continuing from the above discussion, the knowledge of the supply chain process is possessed by people and organizations with perceptions and attitudes directly connected to the

process and thus, the knowledge value cannot be assessed and observed simply through quantitative method. Comparatively, the qualitative method allows the concentration on the subjective perceptions of people concerning knowledge acquisition in the supply chain and the provision of a deeper insight into the supply chain issues. The approach allows the determination of the research questions by illustrating an enriching overview of the actual conditions that surround the supply chain. It also assists in overcoming the risks of using mathematical evidence to reach findings in a socially complex environment – this is one of the weaknesses in the use of quantitative approach (Kelle 2006).

4.4 CASE STUDY STRATEGY

A case study refers to an empirical inquiry into a contemporary phenomenon in an actual context, particularly when there are blurred boundaries between phenomenon and the context (Yin 2013). Case study research may take on positivism, interpretivism or critical approach based on the underpinning philosophical paradigm adopted by the researcher (Oates 2006).

According to Eisenhardt (1995) and Yin (2013), case study research can have quantitative or qualitative evidences. Case studies also facilitate the study and exploration of the complex phenomenon by determining why and how questions . It also examines contemporary events in a natural setting, allows researchers to use multiple data sources for gathering data, examines one or few entities, as well as makes it possible for researchers to study and explore the complexity of phenomenon by answering why and how questions (Benbasat et al. 1987). Researchers that adopt case study method often attempt to obtain in-depth detailed information concerning the study phenomenon (Oates 2006).

Three types of case studies were highlighted by Yin (2013) and they are exploratory, descriptive and explanatory. According to Oates (2006), the exploratory case study is employed by researchers to shed light on a research problem, particularly when there is minimal evidence found in literature about the topic, while descriptive case