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ZHENG HUANG

Fostering Strategic Innovation Management for SMEs

Multiple case studies in China

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ACADEMIC DISSERTATION
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To all my family members

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--All my passion, persistence and patience contributed to this book.

ABSTRACT

This dissertation addresses innovation management studies concerning small and medium-sized enterprises (SMEs) in China. Innovation is regarded as a crucial source of competitive advantage for SMEs. Despite the importance of innovation in SMEs, there are only few studies on SME innovation in developing countries so far. Many studies use single sites to analyse SME innovation. The purpose of this research is to obtain rich insight into the nature of innovation activities in Chinese SMEs, identifying several key factors that determine their innovativeness.

This dissertation is exploratory research that attempts to fill the blanks in academic studies of SME innovation management through both an extensive literature review and substantive knowledge development. By taking a multi-case qualitative approach, it examines the critical driving forces of innovation and analyses different innovation patterns.

The research uses the experience gained from a pilot study to develop a concrete interpretation of SME innovation behaviours. The within- and cross-case analyses are based on the innovation practices of SMEs, with a focus on different types and strategic behaviours. Based on a synthesis of cross-sectoral studies, the research findings indicate that Chinese SMEs involve a number of heterogeneous innovative activities and have their own distinctive features.

This research provides definitions for SME innovation, and facilitates the classification and integration of diverse insights from case studies. It contains a systematic view of SME innovation management. Through the integration of existing theories, a generic conceptual model is developed for SMEs to manage their innovation process and accelerate innovation activities. The model offers a holistic framework for enhancing strategic innovation successfully in a fast-changing environment. In addition, the model provides an explanation of the underlying mechanisms of innovation management in SMEs.

Thus, the dissertation investigates innovation in Chinese SMEs at firm level increasing current understanding of their innovative characteristics. The contribution of this study is in integrating innovation processes into a comprehensive conceptual framework for fostering strategic innovation in SMEs.

KEYWORDS: SME, strategic management, innovation patterns and activities, China

TIIVISTELMÄ

Tämä väitöskirja käsittelee innovaatiojohtamista ja tutkii sitä kiinalaisten pienten ja keskisuurten (pk) yritysten kontekstissa. Innovaatioita pidetään ratkaisevana kilpailuetuna pk-yrityksissä, mutta niiden tärkeydestä huolimatta tutkimuksia kehittyvien maiden pk-yritysten innovaatiotoiminnasta on tehty hyvin rajallisesti. Monissa tutkimuksissa käytetään yksittäisiä yrityksiä analysoitaessa pk-yritysten innovaatiotoimintaa. Tämän tutkimuksen tarkoituksena on saada moniulotteisempi käsitys innovaatiotoiminnan luonteesta kiinalaisissa pk-yrityksissä yksilöimällä useita keskeisiä tekijöitä, jotka määrittelevät näiden yritysten innovatiivisuutta.

Tämä väitöskirja on kartoittava tutkimus, joka pyrkii lisäämään akateemisen tutkimuksen tietämystä pk-yritysten innovaatio-johtamisesta sekä laajan kirjallisuuskatsauksen avulla että myös kartuttamalla empiiristä tietoa. Useisiin tapaustutkimuksiin perustuvan laadullisen lähestymistavan keinoin tarkastellaan tärkeimpiä innovaation liikkeellepanevia voimia ja analysoidaan erilaisia innovaatiomalleja.

Tutkimus käyttää pilottitutkimuksesta saatuja kokemuksia kehittäen konkreettisen tulkinnan pk-yritysten innovaatiokäyttäytymisestä. Tapaustutkimusten sisäiset ja väliset analyysit perustuvat pk-yritysten innovaatiokäytäntöihin keskittyen yritysten erilaisiin innovaatio-malleihin ja strategioihin. Perustuen tapaustutkimusten tuottamien tulosten synteesiin tutkimus osoittaa, että kiinalaiset pk-yritykset käyttävät useita erityyppisiä innovatiivisia toimintamalleja ja kiinalaisten pk-yritysten innovaatiotoiminnalla on omat erityispiirteensä.

Tämä tutkimus auttaa määrittelemään pk-yritysten innovaatiotoimintaa sekä edistää erilaisten tapaustutkimusten tuottamien tutkimustulosten luokittelua ja integrointia. Tutkimus pyrkii tarjoamaan systemaattisen näkemyksen pk-yritysten innovaatio-johtamiseen. Yhdistämällä olemassa olevia teorioita tutkimus luo pk-yrityksille käsitteellisen mallin tukemaan niiden innovaatioprosessien

hallintaa. Tämä malli auttaa tulkitsemaan pk-yritysten innovaatio-johtamisen perusmekanismeja. Lisäksi malli tarjoaa kokonaisvaltaisen kehyksen strategisten innovaatioiden menestyksekkääseen toteuttamiseen nopeasti muuttuvassa ympäristössä.

Väitöskirja tutkii siis kiinalaisten pk-yritysten innovaatiotoimintaa yritystasolla ja lisää ymmärrystä kiinalaisten pk-yritysten nykyisen innovaatiotoiminnan ominaispiirteistä. Tämän tutkimuksen kontribuutiona on integroida monen tyyppisiä innovaatioprosesseja kattavaan käsitteelliseen viitekehykseen ja tätä kautta tukea pk-yritysten strategisia innovaatioita.

AVAINSANAT: pk-yritys, strategiajohtaminen, innovaatiomallit ja -toiminnat, Kiina

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ABBREVIATIONS

B2B	Business to business
CAGR	Compound annual growth rate
CAD	Computer-aided design
CAM	Computer-aided manufacturing
CAN	Chinese Nursing Association
CEO	Chief executive officer
CTO	Chief technology officer
ERP	Enterprise resource planning
GEB	Growth Enterprises Board
GDP	Gross domestic product
GMP	Good manufacturing practices for pharmaceutical manufacturers
HR	Human resources
IPRs	Intellectual property rights
IMF	International Monetary Fund
LMEs	Large and medium-sized enterprises
MOST	Ministry of Science and Technology
NPD	New product development
OECD	Organisation for Economic Co-operation and Development
OEM	Original equipment manufacturer
QMS	Quality management system
R&D	Research and development
RBV	Resource Based View
SFDA	State Food and Drug Administration
SIOM	Shanghai Institute of Optic and Fine Mechanics & Chinese Academy of Sciences
SME	Small and medium-sized enterprises
TQM	Total quality management
WTO	World Trade Organization

INTRODUCTION

Today's business environment is challenging and competitive, as technology changes rapidly and product life cycles become shorter. Innovation is recognised as one of the most critical factors for success in such a fast-moving market, and is becoming an increasingly powerful determinant of company survival, development and success. Innovation allows some firms to grow at a faster rate than others, and is an important focus for companies, regardless of size and industry. Moreover, innovation is viewed as the most powerful driving force for a firm's sustainable development. Innovation can be a significant element of competitiveness (Porter, 1996). It is particularly necessary for small and medium-sized enterprises (SMEs) to survive and grow in the marketplace (Laforet & Tann, 2006).

Innovation is needed not only in large firms but also in small firms. Innovation processes are distinguished greatly between large and small firms. An SME cannot be seen as a "little big business" (Hill et al., 2002). Small enterprises are not simply down-scaled large firms (Culkin & Smith, 2000). SMEs have their own features that differ from those of larger firms in terms of available resources, competitive positions, organisational structures, managerial styles and operating strategies (Chen & Hambrick, 1995; Ebben & Johnson, 2005; Man, Lau, & Chan, 2002). Unlike large firms, SMEs may be vulnerable when developing or launching innovations, due to inadequate capability and resources (Narula, 2004; Nooteboom, 1994). The advantages that a small firm has regarding innovation come from its behavioural characteristics, the ways in which specific innovative behaviours affect firm performance require specific analysis (Marques & Ferreira, 2009).

1.1 Scope and focus of the study

SMEs have played a pivotal role in driving local, regional, and national economic growth (Jones & Tilley, 2003; Lee et al., 2010). They are particularly important sources of innovation in economic growth (Keeble, 1997; Pavitt, Robson, & Townsend, 1987). SMEs create an entrepreneurial economy and contribute to increased knowledge, competition and variety (Audretsch & Thurik, 2001; European Commission, 2003). A common argument is that innovations in small firms and in large firms are very different (Acs & Audretsch, 1990, Audretsch, 2001; Verhees & Meulenberg, 2004). Compared to larger firms, SMEs innovate in a distinctive way that is attributed to behavioural advantages (Rothwell & Dodgson, 1994). They are more willing to take risks, are less bureaucratic, and can act quickly in response to changes and opportunities in their environment (Allocca & Kessler, 2006; Dhawan, 2001).

On the other hand, SMEs face innovation obstacles of size, resources and capabilities. SMEs need to rethink their existing competitive strategies. In order to adapt to complex and fast-changing environments, SMEs should be concerned with their market positioning, technological trajectories, competence building and overall organisational processes (Tidd, Bessant, & Pavitt, 2005).

Although the phenomenon of innovation and its study are hardly new (Verloop & Wissema, 2004), there remains a lack of detailed understanding of how innovation actually takes place in SMEs (Hoffman et al., 1998; Radas & Božić, 2009). Innovation in SMEs is still treated almost entirely as an internal process within a simple framework. In reality, however, the innovation phenomenon in any SME is notoriously complex and diverse. Over the past 35 years, innovation in SMEs has attracted considerable research attention, although several research areas have not yet been satisfactorily addressed. A number of publications provide a monochromatic perspective on SME innovation activities.

The innovative behaviour of SMEs is complicated and difficult to evaluate in practice. Despite many researchers having made valuable contributions to understanding those behaviours, current knowledge is still greatly fragmented due to the lack of unity in the diverse insights

into SME innovation. Although a considerable number of researchers have explored a broad range of innovation process models (see Edwards, Delbridge & Munday, 2005), the innovation models proposed by those researchers are mostly one-sided in focus or highlight linear processes. There has been less attention to studying SME innovation models from a more holistic perspective.

In overviews of the study of innovation, there is a growing trend toward investigating SME innovation in particular. More and more scholars begin by examining some of the assumptions underlying current business and management domains. Innovation is crucial to SMEs if they are to achieve sustained competitive advantages. SME innovation is influenced by internal and external elements and actors. Extant research has pointed out the importance of SME innovation, but does not elaborate on how to manage innovation systematically and organise it for SMEs. Many prior studies have focused on only one aspect of SME innovation. Furthermore, earlier studies do not explain the paths of strategic innovation development and lack an articulation of the many elements in the innovation process. Few studies have clearly demonstrated the actual processes relating to innovation-generating activities. The relationship between firm-level practice and innovation activities represents an important area of research that is underdeveloped in the previous literature on SME innovation.

1.2 Research objectives

The contemporary study of innovation tends to be more comprehensive and diverse than research from earlier generations. In addition, the study of SME innovation in emerging economies has become a hot topic (Tang & Tang, 2010). However, there are a limited number of studies in the field of SME innovation, particularly in developing countries. Over the past two decades, Chinese SMEs have grown significantly, becoming key players in China's economy (Chen, 2006). SMEs currently account for over 99.7% of enterprises in the country, contributing to economic growth and increasing employment. Although SMEs in China have attracted some degree of research attention, investigations of them are still relatively scarce, so SME innovation in China remains under-

researched. Empirical research into innovation activity in the Chinese context has focused primarily on large firms (Li & Mitchell, 2009). Moreover, most recent empirical research on SMEs in China has been conducted using quantitative approaches. There is a scarcity of qualitative research that identifies innovation varieties in Chinese SMEs.

There is thus a real need for much better identification of the key features of Chinese SME innovative paths, and for a deeper understanding of the context in which particular strategic approaches have been pursued. This study attempts to fill some of those gaps. Exploring Chinese SME innovative behaviours has both an academic and a practical value. The objective of this research is not only to gain specific insight into the innovation trajectory of Chinese SMEs, but also to extend the scope to include SME strategic innovation, innovation patterns and innovation activity perspectives.

There is a need to view SME innovation in terms of both the SME context and the aspects of innovation. Successful innovation includes core resources, processes, critical actors and particular capabilities. Improving capability and gaining resources can be considered as essential parts of innovation management. This research offers a comprehensive understanding of SME innovation behaviours from empirical studies, thus guiding SME innovation management in a strategic fashion. It is concerned with the important contemporary question of enhancing SME competitiveness, and demonstrates the important mechanisms that link the innovation capabilities of firms to internal and external resources.

The purpose of this study is to examine the critical driving forces of innovation and to classify different innovation patterns through a multiple case study of Chinese SMEs. It attempts to identify key elements and processes that determine a given SME's strategic innovation in order to develop a concrete analysis of how and why firms innovate differently. Few SMEs use formal mechanisms and procedures to manage innovation processes. At the end of the study, an integrative model is established that offers recommendations to SMEs about how to build and develop their innovation process and strengthen their competitiveness. It offers SMEs a structured approach to managing innovation strategically in the long run.

1.3 Research questions

My research interest is the broader field of innovation management. I developed a specific research question for the present study, the aim of which is to cross theoretical boundaries and integrate the theoretical perspectives of innovation theory. This study highlights important contemporary questions involving the enhancement of innovation management within SMEs.

With great interest in this research and a country-specific background, I chose to focus on studying Chinese SMEs. I narrowed down my research interest within SME innovation, before carefully crafting specific questions. These questions are considered in this study only from the perspectives of innovation variety and behaviours in reference to SMEs. The following are the major research questions of this study:

The main research question is How do SMEs innovate in the Chinese context? To answer this question, three sub-questions are formulated and elaborated as follows:

RQ1: What are the motivations and drivers for SMEs to innovate?

RQ2: What kind of innovations have they developed in practice?

RQ3: How have they carried out the processes related to these innovations?

The research task is to address those questions using empirical evidence from Chinese SMEs. Undertaking a qualitative cross-case analysis, I try to find answers by interpreting factors which influence innovation in small businesses. This explorative study focuses on diverse patterns of innovation by examining differences in the innovation-related activities of firms, particularly highlighting the experiences and achievements of case firms. My ultimate goal aims to contribute to the study of SME innovation management.

1.4 Methods

This PhD thesis can also be considered an explorative study. It investigates the critical success factors and different types of innovations

in five SMEs in China across different industries. The research employs qualitative research methods to discover how those enterprises manage strategic innovation and develop and implement specific innovation activities. During the research process, I had the opportunity to obtain a deep insight into Chinese SMEs in real-world contexts. According to data collection and interviews, all five enterprises were found to be innovative, but each case reflects its own distinct innovative characteristics. Chinese SMEs are involved in a number of heterogeneous innovations: product, process, marketing, organisational or technological innovations. The case study data was systematically investigated to present the various innovative activities of the Chinese SMEs. I identified the various features of innovation patterns and summarised them into different categories based on a cohesive set of related innovation literature and real-world evidence. The results imply a series of innovation patterns and strategies that take place in Chinese SMEs. This explorative research offers an enhanced understanding of Chinese SME business operations and management practices, especially those concerning innovative strategy and competitiveness. Drawing upon three bodies of literature, I argue that managing SME innovation requires a systematic approach. I formulate an integrative framework to manage and organise innovation for SMEs. I conclude by outlining several of the study's crucial implications and suggesting further questions and avenues for future studies in SME innovation fields.

1.5 Contributions of the study

This dissertation makes several contributions to recent understandings of how to organise and manage innovation in SMEs to gain strategic advantages. The contributions are both theoretical and practical. The achievement of this research is three-fold. First, it is one of the few studies of innovation activity that spans a cross-section of Chinese SMEs. By drawing on multiple case studies and micro-level evidence, I uncover the key factors affecting SME innovation success. Second, this dissertation opens a window into the SME situation in China today, drawing a practical portrait of the kind of innovation underway in Chinese SMEs. The different patterns of innovation in Chinese SMEs are

identified and analysed. The empirical data has been systematically investigated to present the various innovative activities found in Chinese SMEs. Third, a conceptual model is formed as a theoretical framework involving three key processes to improve SMEs' innovation management.

The ambition of this dissertation is not to create an entirely new conceptualisation of theory, but rather to build a conceptual framework useful for SME decision-making about which innovation strategies to pursue. I adopt a holistic view to study SME innovation, striving to paint a 'big-picture' model by providing a systematic approach that SMEs can adopt to facilitate a distinctive innovation strategy. The findings should offer practical value for managers to organise and manage innovation activities more appropriately and help policymakers to foster better innovation environments. The research results should also provide several avenues to researchers and practitioners for future study of SME innovation phenomena. The implications should guide SMEs in the ways they can develop their innovation strategies, primarily through the combination of various capabilities and resources. This study attempts to contribute to both theoretical knowledge and managerial practice in contemporary SME innovation literature.

Furthermore, this research is also beneficial to other academic audiences. By focusing on a specific topic, this study makes a modest but genuine contribution to current thinking and research practice. It can increase our understanding of Chinese SME innovation behaviours in a transition economy. Some findings of this study can hopefully be utilised later or in other fields. I have made an effort to present an up-to-date picture for all readers. I hope that this study will provide new scientific input in the research domain of SME innovation management.

1.6 Outline of the dissertation

This doctoral dissertation includes seven chapters, which are organised as follows.

Chapter 1 offers an overall introduction to the dissertation. The objectives of the study and the research questions are defined.

Chapter 2 explicates the different meanings of innovation, alongside a brief review of its definitions and classifications. The dimensions of

current SME innovation are given in this study. The official definition of a Chinese SME is introduced and the development and current status of Chinese SMEs are also presented in this chapter.

Chapter 3 reviews the existing significant literature on SME innovation domains, focusing on recent developments in innovation research. Three relevant theories are discussed. Network theory provides the best basis for understanding the different actors involved in SME innovation processes, while the resource-based view (RBV) contributes to helping SMEs think about their capabilities and resources and the need for system-integrating capability. Entrepreneur orientation theory explains how entrepreneurial SMEs tend to be more proactive in adopting innovation strategies.

Chapter 4 describes the details of the research methods, process and structure. The questionnaire design and sample selection processes are introduced, the process of data collection and data analysis are elaborated in detail.

Chapter 5 provides a rich analysis of each case, as well as a short summary of results. The firm-level analysis addresses the different innovation patterns in Chinese SMEs. The implications of each case are stated. The outcome of the analysis identifies the key actors and elements that influence the innovation processes.

Chapter 6 draws together some of the common findings from the cross-case comparison studies, leading to discussions that answer the proposed research questions. By synthesising the empirical evidence, the results reveal the theoretical and managerial implications of the study as a whole.

Chapter 7 introduces the conceptual innovation model by bringing together the research results and previous literature. It offers an integrative approach to successfully enhancing the strategic innovation management of SMEs. A comprehensive innovation model is formulated by focusing on three key processes to build SME innovation capabilities. The limitations of this research are discussed from six perspectives. Several important conclusions are provided for SMEs, before expectations of and suggestions for additional areas for future innovation research are presented.

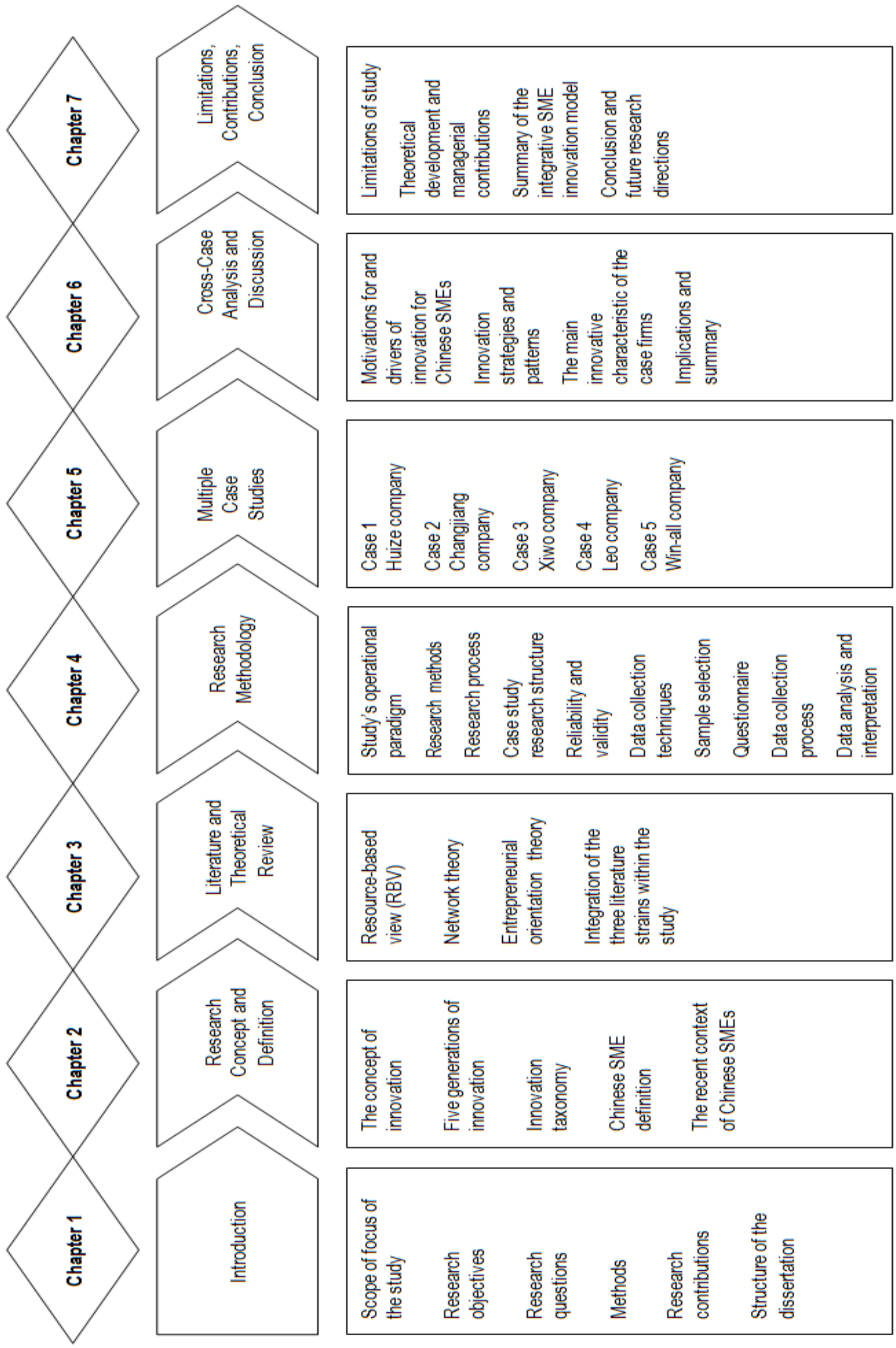

Figure 1. Structure of dissertation

2 KEY CONCEPTS OF THE STUDY

2.1 The concept of innovation

Innovation is an important topic in a wide variety of contexts. The concept of innovation has been enlarged extensively to include numerous new perspectives in the past few decades. According to Damanpour and Schneider (2006), innovation has been studied in various disciplines and its definition has become both wider and more nuanced. There are many definitions of innovation from different domains in the scientific literature.

The term "innovation" is a kind of difficult concept to define. Because it is complex and broad, innovation can be explained in various ways. To understand the nature of innovation more completely, the conceptual background of innovation will be introduced and the classification of innovation will be discussed. In this chapter, multiple dimensions of innovation are reviewed to provide an overview of existing scholarly understandings in the field of innovation management.

What is innovation?

Innovation is a type of multi-faceted phenomenon (Rosenbusch, Brinckmann, & Bausch, 2011; von Hippel, 1990). Innovation has many facets and is multidimensional, spreading across numerous research disciplines (Baregheh, Rowley, & Sambrook, 2009; Tidd, 2001). A great volume of literature has been devoted to innovation, with various categories and models introduced (e.g. incremental versus radical innovation, product versus process innovation, technical versus administrative innovation, systemic versus component innovation, close versus open innovation).

Innovation must be new or different: Innovative actions should be a change in routine arising from novelty and new solutions. The word "innovation" originally "comes from the Latin 'in' and 'novare' to make

something new, to change" (Bessant & Tidd, 2007, p. 12). An innovation can actually be something new, or merely significantly improved, or perceived as new. In the Oxford English Dictionary, innovation is defined as "a new method, idea, product, etc." Innovation is related to other concepts like change, invention, creativity and adaptation (Pierce & Delbecq, 1977). Nord and Tucker (1987, p. 6) describe innovation as a "technology, strategy, or management practice that a firm is using for the first time, whether or not other organisations or users have previously adopted it", or "as a significant restructuring or improvements in a process". Damanpour characterises innovation as "the generation, development, and adaption of novel ideas on the part of the firm" (1991, p. 556). Innovation can be interpreted as an entirely creative activity, a significant change compared to previous achievements or substantial improvements in products, processes or services (Harper & Becker, 2004). Regardless of specifics, some element of real or perceived novelty or newness is the core feature of innovation (Johannessen, Olsen, & Lumpkin, 2001; O'Sullivan & Dooley, 2009). According to the Organisation for Economic Co-Operation and Development (OECD) definition in its Oslo Manual, all innovation must contain a certain degree of novelty. Moreover, innovation cannot be viewed only as creation; it also includes the transmission and diffusion of new knowledge. The concept of innovation refers to "the transformation of an idea into a marketable product or service, a new or improved manufacturing or distribution process, or a new method of social service" (European Commission, 1995, p. 4). Cooper (1993) and Kotabe and Swan (1995) suggest that innovation can be measured by newness to a given firm or newness to the broader market or a combination of the two. Cosh and Hughes (1996) prefer "new to the firm only", "new to the firm's industry" and "new to all industry" in a survey of UK SME innovative activity. In more recent research that reflects a globalised world, the newness of innovation has been classified into three levels, "new to the firm", "new to the national market" and "new to the international market" (Jensen et al., 2007; Community Innovation Survey, 2008a; 2008b).

Innovation differs from invention: Innovation is usually conceptualised in terms of ideas, learning and the creation of knowledge. There is a significant distinction between innovation and invention.

Invention means creating things that have never existed before; it is coming up with a new idea or the core elements of an initial product concept. By contrast, innovation means much more than invention. It is the successful exploitation of ideas to commercial applications, and typically entails the commercialisation of invention (Schumpeter, 1942). It is analogous to "invention + commercialization" (Afuah, 1998; Garcia & Calantone, 2002). Innovations need to be successfully diffused in the marketplace. In other words, innovation makes ideas practicable and available in the market to create an economic impact. Innovation goes much further than invention, embracing "not only basic and applied research but also product development, manufacturing, marketing, distribution, servicing, and later product adaptation and upgrading" (Kumar & Phrommathed 2005, p.7).

Innovation is not merely a number of new ideas: Innovation activity transforms a good idea through successful product development into the final market launch. An innovation cannot be realised until it is implemented or commercialised (Van de Ven, 1986). Innovation efforts are not limited to technical research and development (R&D). Innovation is the implementation of new ideas in an attempt to create value, creating new customer expectations, setting new standards and making possible new positive customer experiences. Accordingly, innovation is built on a great deal of ideas but goes beyond them. New technology often creates new markets which were not even conceivable until that new technology created new demands. Innovation both responds to and shapes market demands, transforming ideas and opportunities into commercial outcomes (Tidd, Bessant, & Pavitt, 2005). A successful innovation entails both the conception of an idea and its subsequent translation into something of practical and thus commercial value.

What are characteristics of innovation?

Innovation must be an action rather than an accident. Innovation does not occur spontaneously or by chance. Innovation not only includes a major breakthrough innovation or a creative innovation, but also means a series of small-scale, incremental changes. Innovation is derived from commitment and day-to-day efforts. According to Drucker (1969, p. 52),

"innovation is not flash of genius, it is hard work". In the same vein, Gaynor (2002) asserts that innovation rarely needs individual genius; rather, it needs to be managed diligently, and systemic efforts made to explore potential opportunities (Lin & Chen, 2007). Managing and organising innovation is a delicate task, needing not only the involvement of the entire enterprise but also a daily operation (McAdam, Keogh, Reid, & Mitchell, 2007).

Innovation must be aimed at bringing benefit to firms or to society. Innovation activities can create benefits and returns. There are many motivations behind innovation activities, from survival to expansion. Innovation can boost growth, increasing productivity and profits (Heunks, 1998). The purpose of innovation is to create new or added value for customers and financial returns for firms (Schramm et al., 2008). The essential incentive of innovation involves obtaining profits by responding to demands, which implies that innovations are driven to try to understand, interpret and manipulate customer preferences and consequent choices. Increasing profitability is a great trigger to companies pursuing innovation, and innovation as a whole is positively associated with overall economic growth. Innovation not only yields economic value to firms and diffuses its upside to other business units (Garcia & Calantone, 2002), but also contributes to the sustained development of social welfare and economic prosperity (Schumpeter, 1934; 1942).

Innovation is inherently risky, costly and difficult. Innovation is characterised by high risk and uncertainty. Most examples result in the failure of new technologies and products or services that did not enjoy commercial success in the marketplace. It is impossible to predict with precision the costs and outcomes of any given innovation. The innovation process traditionally involves a substantial amount of capital and other assets, such as human and technological resources, and always poses substantial risk (Caputo, Cucchiella, Fratocchi, Pelagagge, & Scacchia, 2002). The outputs of innovation are unknown and the desired returns are not guaranteed.

Innovation can be described as a process or a "continuum with multiple dimensions" (Green et al., 1995; Malmberg & Power, 2005). Innovation is better understood as a multiphase process rather than a single event (King, 1992; Kastelle & Steen; 2011; Tidd, 1997), a series of

activities rather than a single act (Ahmed & Shepherd, 2010). It is a kind of cumulative process (Dosi, 1990) with a feedback loop, ranging from initiation to adoption and implementation (Pierce & Delbecq, 1977; Damanpour & Schneider, 2006), and moving from novel ideas through to market launch. The typical innovation can be defined as a nonlinear, interactive, dynamic process with the involvement of many elements and interaction among actors (Kline & Rosenberg, 1986; Malecki, 1997). Meanwhile, the process can be realised in the cooperation and economic and social interaction of different actors, with the result producing technological, organisational and social innovations (Koschatzky, 2001, p. 62).

Innovation is an interactive process: Innovation is also an action-related concept consisting of action and interaction. It is better understood not as a linear process but as an interactive dynamic process (Pavitt, 1984). External relations are very important for the innovation activities of firms (Dosi, 1998; Malecki, 1997; Kline and Rosenberg, 1986). The innovation process is shifting from an R&D-focused activity towards an integrated process requiring the involvement of many units, both within a firm and across firms. It has also been recognised as a process of interactive learning (Lundvall, 1992, 2010), involving people in different departments or relationships between firms with different organisations (Kline & Rosenberg, 1986). It is a sort of integral activity that demands the involvement of the whole organisation (Kline, 1985; Martinez-Roman et al., 2011; Nelson and Winter, 1982; Yam et al., 2011). Furthermore, innovations are now often facilitated by external linkages, synthesising the knowledge and resources of various actors (Jørgensen & Ulhøi, 2010). Innovation processes have become increasingly seen as collaborative processes (Maula et al., 2006). In this new era, the paradigm of the innovation process is not individual or independent, but involves a systemic approach that integrates and interacts with external actors (Chesbrough, 2003).

Why is innovation important?

Innovation is key to strategic advantage and sustainable development. Innovation can enhance a firm's competitiveness, and is viewed more and more as an essential factor of competitive advantage. From Porter's

viewpoint (1990, p. 45), innovation can be defined "as attempts to create competitive advantage by perceiving or discovering new and better ways of competing in an industry and bringing them to market". Innovation is viewed as a powerful approach to gain competitive advantages, as Porter adds: "Companies achieve competitive advantage through acts of innovation. They approach innovation in its broadest sense, including both new technologies and new ways of doing things" (1990, p.179). Firms facilitate innovation to improve their competitive advantage.

Innovation is more vital today than ever before, especially for SMEs. Innovation has become imperative to firms. Innovation is particular important to SMEs as noted by Drucker (1985, p. 32): "... innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a business or service[...] It is capable of being presented as a discipline, capable of being learned, capable of being practiced".

2.2 Five generations of innovation models

The context of innovation has changed profoundly over the past decade. Firm-level models of innovation process have ranged from linear models through chain interactive models to multi-networking models (see Rothwell, 1992; Hobday 2005). Below I provide a historical review of innovation management and process models development over time.

Table 1. Rothwell's five generations of innovation models (1994)

Generation	Models	Main characteristics	Period
First	Technology-push/science push	A simple linear process of technology commercialization, moving from R&D to market, highly technology-focused	1950s - mid-1960s
Second	Market-pull/need pull	A simple linear process from marketing to R&D, focus on market demand to meet customer requirements	Mid-1960s - early 1970s
Third	Coupling model	A combination model of technological push and market pull with feedback loops, recognising interaction between different elements	Early 1970s - Mid-1980s
Fourth	Integrated (Chain-linked) model	A parallel model, backward and forward links with key suppliers and customers	Early 1980s - early 1990s
Fifth	System integration and Networking models	A system integration model, extensive networking supported by advanced information technology, continuous innovation involving various actors	Early 1990s - now

Roy Rothwell (1994) describes five generations of the innovation process model. The first-generation model of innovation process was "technology push or science push", while the second generation was "market pull or customer pull". Both are early models that view innovations as functional activities. The "technology push" model is a kind of supply-side approach

to the innovation process, going from R&D to customers or users. New or technologically innovative products were pushed onto the market. Innovation primarily occurs in reference to technology or science, with a heavy emphasis on R&D. Conversely, the "market pull or customers pull" innovation model moves in the opposite direction. The innovation process runs from the marketplace to R&D, shifting to a market focus that responds to customer needs. Market demands become the main driving force in new idea generation and technical evolution. Despite the distinction between the two models in terms of the opposite direction of innovation processes, both the push and pull models are very simple constructs that rely on a sequential, linear process (Hobday, 2005). The third-generation model of innovation is so-called "coupling model" that is a structured process between technological development and market demand, involving both push and pull. The combination of R&D, production and marketing interacts at different stages, linked with a feedback loop between upstream and downstream phases of innovation. The coupling model aims at operational cost reduction inside firms. The fourth-generation model is a parallel and integrative process, which includes the integration of cross-functional departments within firms and close upstream and downstream collaborative relationships, linking up with both key customers and important suppliers. Knowledge is also involved in the innovation process. The fifth-generation model is "system integration and networking model". This generation sees innovation process as occurring in a multi-actor system, encompassing high levels of extensive intra-organisational and inter-organisational networking. It is a kind of diverse, high-involvement innovation based on extensive networking with multiple relationships, such as cooperation, strategic alliances, partnerships, and so forth. It represents the contemporary innovation process model that we need to address and understand.

2.3 The development of innovation literature

Innovation is inherently a multilevel phenomenon (Gupta et al., 2007). Innovation as a business and economic concept has been studied at different levels and from different perspectives, spanning macro, meso to micro. Innovation in the field of managerial research can be studied at

international, national, regional, cluster, industrial, organisational, team or individual levels. I briefly present an overview of the theoretical divergence and development of innovation literature, covering an array of levels and mainstream of innovation studies in Table 2.

Table 2. Changes and divergence in the literature on innovation management

	Key changes	**Key features**	**Scholarly examples**
1	Linear model to non-linear model	R&D is not a linear process; it is more like triangular or circular processes	Nelson & Winter, 1982; Edquist, 1997
2	Technology/ R&D push (Schumpeter, 1934) to market/demand pull (Schmookler,1966)	Understanding and meeting customer needs	Christensen, 1997; Christensen & Raynor, 2003; von Hippel,1998
3	Individual perspectives to Structure perspectives	Considering different elements in innovation process, as a series of discrete steps or stages. Process innovation and product innovation are both important	Zaltman et al.,1973; Wolfe, 1994; Clark & Saunton, 1989
4	Interaction process models with feedback loops	Interactive process crosses organisational boundaries between the firm and its environment, inter-organisational networking to innovation with streamline shared processes, etc.	Van de Ven & Poole,1988; Pettigrew,1985; Walton, 1987; Kline & Rosenberg,1986; Dosi, 1988; Koschatzky, 2001
5	Sectoral or industrial patterns of technological innovation	Industrial sectors are diversified by a set of the sources, paces and rates of technological change	Pavitt, 1984; Carlsson & Stankiewicz, 1995; Breschi & Malerba, 1997; Malerba 2005

	Key changes	Key features	Scholarly examples
6	Regional/cluster of innovation	Geographic clusters and agglomerations for firms in generating innovation to achieve competitive advantage	Braczyk et al., 1998; Capello, 1999; Cooke & Morgan, 1998; Cooke,et al., 2000, 2004; Keeble et al., 1999; Saxenian, 1994; Doloreux 2002, Asheim & Isaksen, 2002; Porter, 1998;
7	National level innovation system and knowledge learning	Government policy supports innovation, regional innovation and knowledge diffusion, national institutions (e.g. Education)	Lundvall, 1992; Nelson, 1993; Lundvall & Johnson, 1994; Edquist, 1997, 2005; Etzkowitz & Leydesdorff, 1997
8	Vertical network to the systemic integration and extensive networks or "engineered networks"	Flexible and customised response, continuous innovations	Powell et al.1996; Mowery et al.1996; Conway and Stewart, 2006
9	Closed innovation to open innovation	Shifts from in-house innovation to acquisitioning, learning or development of idea and technological competence from outside	Chesbrough, 2003, 2006, 2007; West et al., 2006

According to a review of the different innovation literature, many scholars have contributed significantly from different theoretical perspectives. Nelson and Winter (1982) and Edquist (1997) suggest that innovation is not a linear process, but more likely a triangular or circular process. Innovation is characterised by Rosenberg (1982) as a kind of 'black box' with technology input, but also containing certain outcomes.

Innovation should to response to customer needs, from understanding lead users to anticipating tomorrow's innovation directions (Christensen & Raynor, 2003). Von Hippel (1998) suggests that new technologies are developed by working closely with external customers, keeping in line with customer needs.

Some previous studies have focused on individual and structural perspectives in the innovation field, analysing different elements in the innovation process. The structural perspective sheds light on organisational characteristics. Zaltman et al., (1973) developed a contingency theory of innovation, arguing that innovation is determined by the structural variables of the organisation, not the actions of individuals. Following Clark and Staunton's (1989) analysis of innovation through structural repertoires, Wolfe (1994) delineates the innovation process as consisting of sequential stages. However, different researchers conceptualise the stages in different ways, such as the stage–gate process model (Cooper, 1993).

Kline and Rosenberg (1986) propose "interactive models of innovation" by adding feedback and loops to the innovation process. The innovation process crosses organisational boundaries between the firm and its environment; inter-organisational networking to innovation with streamlined shared processes. The emphasis of this research school is dynamic innovation. Innovation is regarded as an evolutionary, cumulative, recurring process.

In early innovation research, innovation activities are believed to be generated in the individual companies. Afterwards, a strongly emphasised area from this perspective was the relationship between the organisation and the environment. Scholars in the field of sectoral/industrial innovation studies shed light on industrial specialisation. They argue that differences in technology, industrial density and competition may impact on a firm's innovation patterns (Pavitt, 1984; Carlsson & Stankiewicz, 1995; Breschi & Malerba, 1997).

Cluster innovation studies focus on geographical concentration in regions or specialised industrial agglomerations (Porter, 1998). Clusters consist of an array of linked industries and other entities with similar skills, technologies and input (Saxenian, 1994). Schools of regional systems of innovation research (Cooke & Morgan, 1998; Cooke et al. 2000, 2004; Doloreux, 2002) increasingly focused on relationships between innovation activity and external systems. Regional innovation systems are characterised by co-operation in innovation activity between firms, knowledge creating and diffusion, local learning processes and spill-over effects (Keeble et al., 1999). A regional innovation system is defined as a sustainable innovation-based learning economy (Asheim

and Isaksen, 2002), interacting with firms and institutions from both the public and private sector.

In the later development, scholars into systems of innovation concentrated on the influence of institutions on innovation. National systems of innovation are country-wide innovation systems with government policies that influence the innovation process (Lundvall, 1992). Institutional environments promote a learning-based economy, particular education system, R&D intensities and technological bases (Lundvall & Johnson, 1994; Edquist, 1997, 2005). Etzkowitz & Leydesdorff, (1997) depict a helix model that embraces three spheres, techno-scientific, economic and political; it concentrates on university-industry-government relations.

There is a growing trend towards trying to establish innovation networks for innovation purposes by bringing various organisations together. Some research studies on "studying networks of inter-organisational collaboration" (Powell, Koput, & Smith-Doerr, 1996) suggest that the innovation process is the involvement of different organisations and the governance of an innovative network structure. Special alliances or innovation networks can be particularly found in technology-based industries such as pharmaceutical or telecommunications (Mowery et al., 1996). Different partners are aligned with innovative goals, aimed at solving innovation problems through networking, and so entail "engineered" networks (Conway and Stewart, 2006). Those innovation networks can be part of a supply chain, or some geographical region or a cluster.

Recently, there is a new generation of innovation studies in the light of open innovation. Chesbrough (2003, 2006, 2007) postulates the "open innovation" concept and paradigm, and explains that innovation trends shift from closed innovation to open innovation, moving from internal innovation processes to more collaborative open processes. The main idea of open innovation is to increase external R&D activities by linking them with others (West et al., 2006).

2.4 Types of innovation

The categorisation of innovation has been widely developed in the innovation literature. Schumpeter (1934) identifies five types of innovations: new products, new methods of production, new sources of supply, the exploitation of new markets and new ways to organise business. Innovation includes product and service, process, marketing and business model, organisational innovation, etc. The OECD's (2009) Oslo Manual classifies innovations into four major categories in terms of process innovation, product innovation, organisational innovation and marketing innovation.

Freeman and Perez (1988) differentiate innovation into two types according to the degree of novelty and the different characteristics; there are incremental innovations and radical innovations. Based upon Schumpeter's "creative destruction" theory, Clayton Christensen (2003) labels innovations as "disruptive innovations" and "sustaining innovations". Radical innovation refers to drastic innovation with great novelty in technology or the exploration of emerging markets in which customer needs had been previously unknown. Radical innovations are completely new, with advanced technology and great novelty in products, processes and services (Garcia & Calantone, 2002). Booz, Allen and Hamilton (1982) depict these sorts of innovation as "new to the world". The term 'radical' means a significant creation that simultaneously affects both the business model and the technology of the firms, and is path-breaking, discontinuous and pioneering. Radical innovations are connected with high uncertainty and risks, and embody a disruptive and breakthrough technological trajectory (Dosi, 1982).

Conversely, incremental innovations are the most widespread style of innovations, and can be understood as small, minor and constantly changing within existing processes, products and services (O'Sullivan & Dooley, 2009). Incremental innovations involve exploiting and some modifications of current technologies or products to meet the needs of existing customers (Henderson & Clark, 1990). Firms carrying out incremental innovations often try to increase productivity, reduce costs, reinforce quality, or run production processes or operations more efficiently (Dewar & Dutton, 1986). These kinds of innovations demand a low degree of new knowledge with regard to upgrading, improving, and

the modification of existing technologies. They are a cumulatively progressing technological trajectory (Hollander, 1965; Myers & Marquis, 1969). Arguably, radical innovation is a kind of "competence destroying", which means establishing or creating a new competence by destroying the old one. In contrast, incremental innovations are similar to "competence enhancing" (Tushman & Anderson, 1986). Ettlie, Bridges and O'Keefe (1984) posit structural differences between incremental and radical innovation, with the former relying more on traditional strategies and structures, and the latter relying on a technologically aggressive strategy and informal structures. Green et al. (1995) depict multiple dimensions of radical and incremental innovation and relate these dimensions to product characteristics. Radical innovations demand more cost and are greater risks than incremental innovations, but they have more profound organisational effects (see, e.g. Cooper & Smith, 1992; Damanpour, 1996; Foster, 1986). It is hard to draw a bright line between radical and incremental innovation.

In addition, some scholars (e.g. Danneels & Kleinschmidt, 2001; Kahn et al., 2003; Massa & Testa, 2008) have argued that the classification of innovation as either incremental or radical is itself too simplistic. They suggest that going beyond two categories may lead to a better understanding of what innovation really means. Abernathy and Clark (1985) propose grouping innovations into the four classes: incremental, component, architectural and revolutionary. This classification stresses that market knowledge can be just as important as technological knowledge for successful innovation. Henderson and Clark (1990) postulate a matrix of four sorts of innovation, refining the radical-incremental distinction into radical, incremental, modular and architectural. Modular innovations concern changes in a new product's components, and architectural innovations are changes in the connections between components. McGahan (2004) outlines four trajectories of industry evolution by combining innovation with the product life cycle model: radical, progressive, creative and intermediating.

Innovation includes product innovations and process innovations. Product innovations mean new or better goods with technological advances and new intangible services. According to Afuah (1998, p.14), product innovations "are new products or services introduced to meet an

external and market need." Product innovations address new market needs and are therefore an important factor in market growth, which imply the two conditions of novelty and use (Gee, 1981). Process innovations are new ways of producing, making and delivering goods and services (Dosi, 1990; Forsman & Serdal, 2014). They may be technological or organisational. Process innovations also include operational enhancements, such as strategic planning and implementation, marketing, production, logistics, quality management and human resource management (Riederer, Baier, & Graefe, 2005). Process innovations are associated with changes in the methods, techniques and procedures of products or services (Camison-Zomoza, Lapiedra-Alcamí, & Boronat-Navarro, 2004). Process innovations are often oriented towards the efficiency and reliability of new solutions in terms of productivity and cost reduction, thereby reinforcing the comparative value of the product. Process innovations include new methods, advances in material input, and modifications in the types of equipment employed, and information flow mechanisms that are used, to deliver a product or offer a service. Both product and process innovation have been shown to be potentially significant sources of strategic advantage (Dibrell, Davis & Craig, 2008).

Frankelius (2009, p.49) points out that "innovation really means something 1) new with high-level of originality, 2) in whatever area 3) that also breaks in to (or obtains a foothold in) society, often via the market, and 4) means something revolutionary for people". According to Chesbrough (2006), innovations can be categorised as two main types, open and closed innovations. His work has recently received significant attention from scholars and researchers.

Although there are comprehensive definitions of innovation, it is necessary to analyse each type individually, as they all require different resources and core competencies. Keith Pavitt (1984) identifies four taxonomic categories of innovating firms, based on the primary sources of innovation. He discusses "supplier-dominated" firms, "specialised suppliers" firms, "science-based" firms and "scale-intensive" firms. In a later paper, Pavitt (1990) added the fifth category as "information-intensive" firms. Pavitt's taxonomy of innovating firms is a significant contribution to the study of technological change. Industrial sectors vary in terms of the sources, paces and rates of technological change (Freel,

2005; Pavitt, 1984). Pavitt's taxonomy is a promising approach to examining the diversity of innovative small firms in sectors (De Jong & Marsili, 2005), and is very useful when studying the variability of innovative patterns in different clusters, even benefitting researchers when exploring distinctions across industries, however, it has some limitations that have been criticised by many scholars. Pavitt's four categories are not suitable for explaining the current fast-changing business world anymore, while the innovation patterns in small firms are more heterogeneous than is suggested by Pavitt's taxonomy. Moreover, the classification is based on a static rather than dynamic outlook (Archibugi, 2001). Pavitt's taxonomy examines innovative activities at the industry level. Empirical work on taxonomy has often neglected the study of the innovative behaviour of small firms, failing to focus on appropriate strategies in their identification and profiling of distinct clusters of small firms.

2.5 Defining innovation in this study

I adopt a broad definition of innovation by taking into account different SME innovation activities. This dissertation attempts to elucidate innovation concepts by identifying and classifying SME innovations at the firm level. The following definition of innovation is employed in this research, from the OECD's Oslo Manual:

> *An innovation is "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*" (2005, p. 46).

The Oslo Manual's definition of innovation covers various types of innovations, including new or improved products, services, operational processes, organisational and managerial processes, business models and marketing methods, etc., as well as considering the external relations of firms. It has become an important reference definition that is widely employed in today's empirical studies, and is thus suitable for analysing the diverse SME innovations in this study.

2.6 Chinese SME definition

The definition of an SME differs according to size in countries around the world (Peres & Stumpo, 2000); it also changes over time. In China, the official description of an SME is quite complicated and larger size than in many countries. Because China is the world's most populous country, enterprises in China generally employ more people than do similar companies in other countries. The new criteria for the classification of SMEs were released jointly by four government ministries on June 18, 2011: the Chinese Ministry of Industry and Information Technology, the National Development and Reform Commission, the National Bureau of Statistics and the Ministry of Finance. The new Chinese SME standard is the eighth revision, replacing an earlier version issued in 2003. Compared with the old standard, the new regulation pays more attention to small businesses. It considers individual businesses and self-employment, adding a new category of "micro-enterprise". Micro-enterprises generally employ fewer than 10 to 20 people. The new division of "micro-enterprise" signifies the accordance of China's SME classification with international standards. It is expected to be very valuable for promoting the sustainable development of Chinese SMEs.

Except size, the relevant standards are basically the same as those used in other countries. The new SME classification uses three indicators, including the number of employees, annual turnover and industry sector. The definition of an SME varies among different industries in China. The new criteria added an additional eight sectors, composed of 16 industries, such as real estate, the transmission of information industry and software and IT services. Compared to other countries, the new Chinese standard for SMEs is still large in reference to the number of employees (see Appendix B).

2.7 The recent context of Chinese SMEs

China's rapid economic growth has received much attention recently. China moved from central planning toward a more market-driven economy from in the early 1980s. China's SMEs are developing under

strong market growth and a booming economy. On the other hand, China's SMEs also provide the main sources of rapid and sustainable economic growth and job creation, especially in the private sector (Liu, 2008). According to statistics from China's Administration of Industry & Commerce, China had 15,278 thousand enterprises by the end of 2013, increasing 11.8% over the previous year. It has 45,641 thousand individual holders and small enterprises, a growth of 2.43% over one year earlier (P.R.net, May 27, 2014).[1] According to China's Economic Reports (second series, 2014), by 2012 there were 325,000 industrial SMEs with annual revenues of more than 20 million RMB.[2]

China's SMEs are also changing from scattered operations to concentrated operations, and from an early focus on the domestic market to pursuing both domestic and international opportunities. Chen (2006) has identified three main economic development phases in the Chinese SME. The first phase (1978–1992) was characterised by the emerging expansion of the Chinese SME sector after the policy of reforming and opening-up in 1978. Private economy and different types of ownership (such as collective ownership and township and village ownership) were first permitted during that period, and initially seen as a supplemental sector to China's primary economic system. At that time, many Chinese markets were unserved; as they were not yet covered by large state-owned enterprises, and SMEs had the best opportunity to fill the gap.

The second phase (1992–2002) was a rapid privatisation process, dubbed the Reconstruction of Ownership. Chinese SMEs began growing rapidly after 1992, partly due to a reform intended to reduce the state's ownership of SMEs through a process of restructuring, mergers and acquisitions. Most state-owned SMEs were transferred to private owners. The Chinese government emphasised improving the overall quality and competitiveness of the domestic SME sector. According to the Information Office of the State Council, from 1998 to 2003, nearly 19 million workers laid off from state-owned enterprises (SOEs) were rehired by private SMEs (Kanamori, Lim, & Yang, 2007, p. 12).

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[1] http://finance.china.com.cn/news/gnjj/20140527/2430607.shtml

[2] http://wenku.baidu.com/link?url=6Fkgqo-68G8ZhKBoSvFR61kJZluRQQk6_hh6ch5jRnMdMd8fyMVfpHH5QPO3Cu8U1r5zv33JNTdFNZ1_qsW19gTfCYBbEL0KBnGhcVSDkrW

The third phase began in 2002, when the government established laws and supporting policies aimed at consolidating and further fostering the expanding Chinese SME sector. The Chinese Small and Medium-sized Enterprise Promotion Law was promulgated in 2002 and took effect in January 2003.[3] The promotion of scientific and technological innovation and upgrading was one of its most important goals. Since then, China's SMEs have been developing rapidly, especially privately owned firms. Many industries and sectors were opened up to small business and entrepreneurial ventures. Chinese SMEs adopt the technological strategy of imitation, assimilation and then improvement (Ren, Zeng, & Krabbendam, 2010). China is moving successfully in the direction of innovation. In addition, the Chinese government has chosen cluster-based SME innovation policies. National clusters and incubators, which were established by both the central government and local governments, provide diverse support for spin-offs and high-technology start-ups. By 2008, China had established over 200 business enterprise incubators, 53 high-tech development zones, over 62 university scientific and technological parks, over 20 enterprise parks for returned overseas students, over 40 service centres for SME technology innovation and more than 500 productivity promotion centres. China's public expenditure on scientific and technological activities and R&D, as a portion of GDP, have risen year every year from 2000 to 2013 (see Figure 2). According to the OECD's Science, Technology and Industry Outlook 2014 report, the Chinese central government is planning to increase R&D spending to 2.5% of the GDP by 2020. Meanwhile, China has minimised the gap with most OECD countries (Hu & Jefferson, 2008). The national-level innovation fund for Chinese technology-based small firms grew rapidly from 2008 to 2013 (see Figure 3).

[3] http://www.gov.cn/english/laws/2005-10/08/content_75040.htm

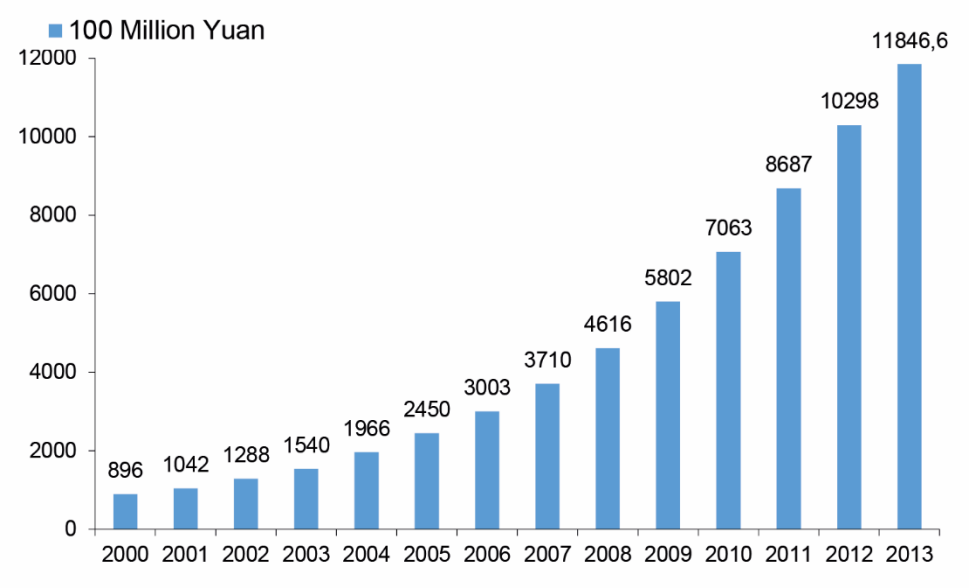

Figure 2. China's expenditure on scientific research and development, 2000–2013 (RBM billion). (Source: China Science and Technology Statistic Data Book 2014 [4])

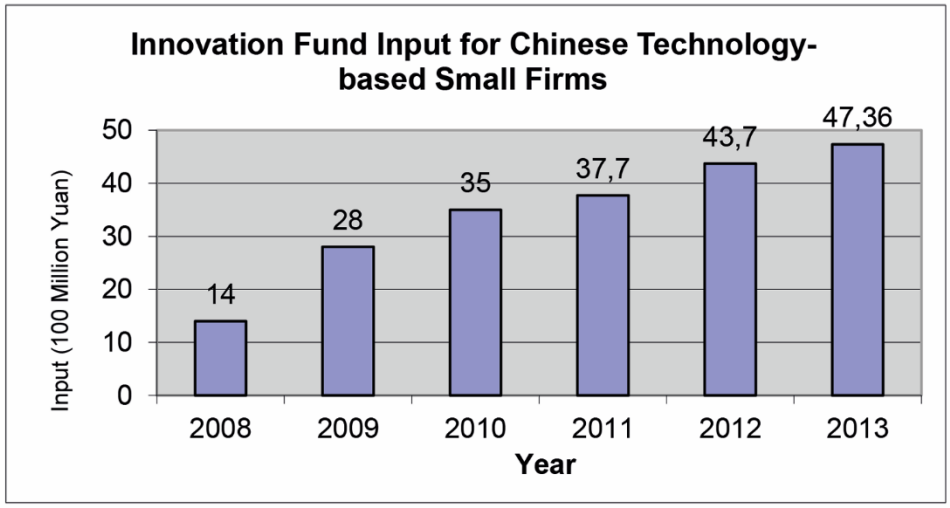

Figure 3. Innovation Fund Input for Chinese Technology-based Small Firms (2008–2013). (Source: China Innovation Fund Annual Report, 2013 [5])

[4] http://wenku.baidu.com/view/c2591775f61fb7360a4c651b.html

[5] http://www.innofund.gov.cn/2/ndbg/201409/972000d0e5a343dcb2a5e46438479c51.shtml

Chinese SMEs have become progressively more important to the nation's economy. SMEs make up 99 percent of the total number of enterprises and account for 60 percent of GDP, 50 percent of tax revenues, 70 percent of the import-export trade and provide 80 percent of urban jobs (see Figure 4). They play a salient role in innovations (Zhu, Wittmann, & Peng, 2012). According to Xinhua news, China's SMEs currently account for 65 percent of all the country's patents, 75 percent of corporate innovations and 80 percent of new product developments.[6] Most Chinese SMEs are engaged in secondary industries like manufacturing and production (see Figure 5). Furthermore, China is focusing its policies on the development of SMEs. According to the Chinese government's 12th Five Year Plan, the total number of Chinese SMEs will grow steadily over the next five years, at an average growth rate of 8 percent per year.

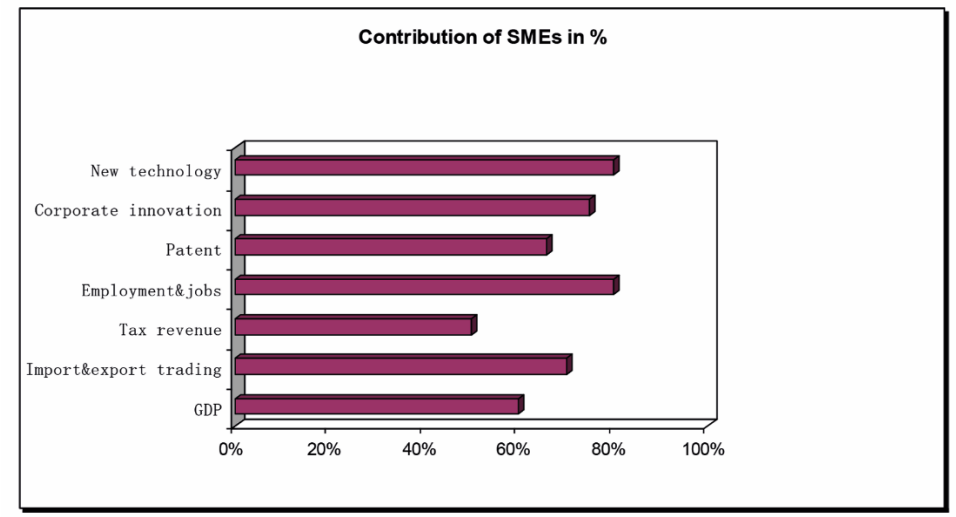

Figure 4. The overall contributions of SMEs in China. (Source: Zhu, Wittmann, & Peng, 2012)

[6] http://news.xinhuanet.com/english/china/2012-06/22/c_131670359.htm

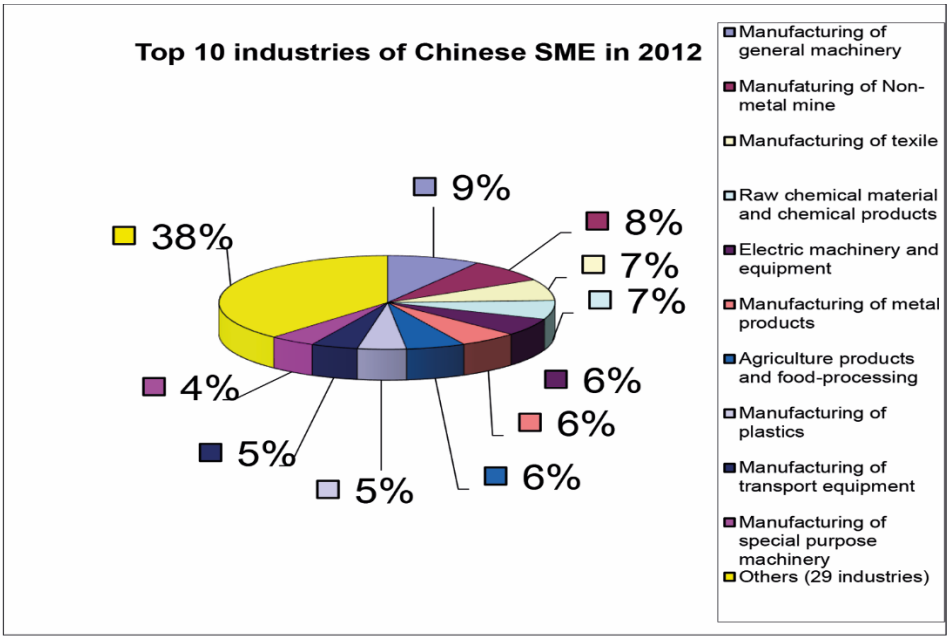

Figure 5. Top 10 industries of Chinese SMEs in 2012. (Source: China's SME Statistical Yearbook, 2013)

3 THEORETICAL APPROACHES TO INNOVATION

In order to strengthen my research and establish fundamental knowledge, I outline the essential principles of three important theories, resource-based view theory, network theory and entrepreneurial orientation theory, and then build connections with SME innovation. In this chapter, I undertake a systematic review of the literature, with special concentration on the application of the three theories to SME innovation research.

3.1 Resource-Based View

The theory of the resource-based view (RBV) was originally postulated by Penrose (1959) and later popularised by Barney (1991). Interest in RBV grew in the mid-1980s and it became one of the rigorous theories of strategic management (Grant, 1996; Newbert, 2008). The RBV sheds light on a set of resources and capabilities as a key issue in understanding a firm's business strategy and providing direction to strategy formulation (Andreu & Ciborra, 1996). It has been growing in popularity in the strategy literature since the late 1980s. A number of scholars have made substantial contributions to its conceptual and theoretical development. A primary scientific assumption of RBV is that firms that own or control diverse strategic resources maybe more competitive than their competitors.

The basic proposition of RBV theory is that there are existing bundles of heterogeneous resources and capabilities across firms (Barney, 1991). RBV argues that the competitive advantage achieved by an enterprise is directly affected by the resources amassed within that company. By looking at the internal resources and capabilities of an organisation, RBV offers one important explanation: if a firm has bundles of heterogeneous resources, this firm's competitive edge is likely obtained based on its idiosyncratic resources (Barney, 1991; Wernerfelt, 1984). It also explains

how organisations achieve a sustainable advantage through the strategic management of their core competence.

Resources can be generally identified as "all assets, capabilities, organisational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness" (Barney, 1991, p. 101). Rangone (1999) suggests that a firm's assets can be divided into tangible and intangible. Tangible resources are the so-called "hard resources" associated with the physical assets that a firm possesses, such as financial resources, human resources or physical resources. By contrast, intangible resources are invisible assets or "soft resources", such as patents, technological resources, brand identity, reputation and networks of relationships. Intangible resources are intrinsically scarce and hard to replicate or imitate (see e.g. Collis & Montgomery, 1995; Hall, 1992; Zahra and Das, 1993). In principle, intangible assets enable the support of a greater level and breadth of activity, therefore contributing more than tangible assets in creating value (Abu Bakar & Ahmad, 2010). Intangible resources are likely to yield more competitive advantage than tangible resources (Hitt, Bierman, Shimizu, & Kochhar, 2001b). The common traits of superior resources are valuable, rare, inimitable and non-substitutable (V.R.I.N) (Barney, 1991; Newbert, 2008). This means the resources are owned or controlled by a firm with a "good" strategic value that should be difficult to copy by rivals. These sorts of resources must be sustainable and appropriable. Firm-specific resources and assets cannot be imitated or duplicated by current or potential competitors.

Prahalad and Hamel (1990) posit the dimension of "core competence" to refer to a firm's central strategic capabilities. They state that a firm's competitiveness is derived from its core competencies. RBV literature implies that a firm's core competencies can be attributed to its unique endowments, but are more likely obtained and maintained through innovation activities. In dynamic environments, knowledge is a key productive source of competitive advantages (Kogut & Zander, 1992). Organisational know-how and the ability to innovate are also included. Spender (1996) points out that an organisation's tacit knowledge and its ability to undertake knowledge evolution are especially important for achieving competitive advantages. Similarly, Kay (1993) suggests that it

is the distinctive capabilities of an organisation's resources that are vital and closely related to its competitive advantages. Barney (1991) argues that long-lasting competitive advantage is more likely to arise from a company's value-creating strategy. This point also refers to an effective method of innovation.

RBV is an often used theory in SME innovation management. SMEs usually have limited financial capital, inadequate knowledge and comparatively few competencies. RBV theory offers a valuable paradigm for interpreting SME innovation activities. According to its influential perspective, the diversity of organisational resources and capabilities strongly impact the outcome of an innovation. On the one hand, RBV points out that the innovation process should involve continual adaptation based on the combinations of strategic assets and should be firm-specific. On the other hand, RBV can help SMEs to develop competitive advantages by striving to innovate, not only better than rivals but also keeping ahead of the competition. RBV expands our knowledge of factors that determine a firm's capability for innovation. In addition to the innovation approach, the creation of sustained advantage depends not only on the company itself, but also on the need to integrate internal and external resources to build core competencies.

Several scholars have elaborated on the different resource types by constructing typologies (Sok & O'Cass 2011). RBV theory is divided into two principal schools of thought (Schulze, 1994). One view holds that a firm's idiosyncratic resources affect the firm's distinctive attributes and performance (Barney, 1991; Peteraf, 1993). A firm possesses "durable, rare, inimitability, and difficult to substitute" resources, those unique resources are helpful in generating competitive advantages over competitors. The other stream of RBV argues that despite resources that have tremendous potential value, a firm's competence and ability to deploy its resources are more crucial elements in yielding sustainable competitive differentiation (Eisenhardt & Martin, 2000; Newbert, 2007; Teece, Pisano, & Shuen, 1997, Sok & O'Cass 2011). Thus, a firm's performance and competitive advantages are associated with the way it manages capabilities (Zahra et al., 2006). Development of a firm's resources is more important than the utilisation of existing resources (Grant, 1991). In addition, sustained competitive advantages take place

when a firm is constantly exploiting a valuable resource-capability combination (Newbert, 2008).

Although RBV has been broadly applied in strategic management studies for many years, it has a number of weaknesses that have received criticism. First, RBV sheds new light upon the firm-specific context, offering an internal analysis of the differences in resource endowments among individual firms. Hooley, Moller and Broderick (1998) criticise RBV for an inward focus that risks ignoring other issues, especially market demand. Hence, RBV is seen as static and fails to address the effect of market dynamism and firm evolution over time (Eisenhardt & Martin, 2000; Priem & Butler, 2001a; 2001b). Second, RBV provides only one lens with which to look inside the firm. It explains a firm's success based on its competencies or resources (Ritter & Gemunden, 2004), but ignores external factors. Third, because RBV highlights internal resources, the definitional issue of a firm's strategic resource remains to be clarified. Many resources are difficult to identify or measure within a firm; it is particularly difficult to classify the degree to which assets affect a firm's strategic decisions. Fourth, if resources are to be unique and inimitable as defined, it raises the question of how firms can develop or acquire them (Fuchs et al., 2000). Fifth, a salient source of core competence for sustainable competitive advantages is vague and ambiguously causal (Lippman & Rumelt, 1982). The value of resources may change and shift naturally over time and thus cease to be a source of idiosyncratic advantage (Leonard-Barton, 1995). Finally, RBV does not elucidate the way that resources are transformed into competitive advantage (Wang & Ahmed, 2007). In summary, RBV theory has limitations in offering clear managerial guidance for firms.

Additionally, Nelson (1991) and Teece, Pisano and Shuen (1990) proposed the term "dynamic capabilities", which has become one of the streams of RBV theory. Teece et al. (1997) posit dynamic capabilities as a source of sustainable competitive advantage. Resource advantages may be temporary or insufficient, and dynamic capability is defined as "the ability of firms to integrate, build and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al., 1997; p. 516). A firm's dynamic capabilities can manipulate resources into creating value. Teece and Pisano (1994, p. 541) develop the dynamic capabilities theory and postulate those particular capabilities as "the

subset of the competences/capabilities which allow the firm to create new products and processes and respond to changing market circumstances". Teece (2007) further formulates the framework of dynamic capabilities. This key dimension makes a significant contribution to extending RBV theory.

Dynamic capabilities, as differentiated from "ordinary" capabilities, are regarded as "the organizational and strategic routines by which managers alter their resource base—acquire and shed resources, integrate them together, and recombine them" (Eisenhardt & Martin, 2000, p. 1107). 'Dynamic capabilities' refers to a firm's ability to renew, re-create and reconfigure to cope with environmental changes, including patterns and paths of capability evolution. Obviously, we can find a significant connection between dynamic capability and innovation. Dynamic capabilities are organisational-level competencies. In sum, dynamic capabilities are generally "concerned with the firm's ability to carry off the balancing act between continuity and change in its capabilities and to do so in a competitively effective fashion" (Dosi, Nelson, & Winter, 2000, p. 6). Dynamic capabilities enable firms to adapt, reconfigure and integrate sets of knowledge and skills, transforming internal and external resources into enhanced firm performance (Lin & Wu, 2014).

Wang and Ahmed (2007) classify dynamic capability into the three main component factors of innovative capability, absorptive capability and adaptive capability. Innovation capability has been posited as a key factor for pre-empting competition (Clark & Fujimoto, 1990). Lawson and Samson (2001) explain that innovation capability is a high-order ability of integrating all of an organisation's key resources and competences, continually converting knowledge and ideas into marketable products, processes or services. Whilst the dynamic capability approach opens up a new area in empirical research, it does not explain methods for achieving capability development. Furthermore, dynamic capabilities research has not been conducted systematically and research findings remain disconnected.

In many current researches, RBV has been widely deployed in the analysis of the innovative behaviour of SMEs. I agree with RBV's position that the specific resources of a firm are of course significant for innovation. RBV theories focus on independent and unique resources

and capabilities of organisations (Barney, 1991; Wernerfelt, 1998). RBV contributes valuable knowledge related to innovation management in terms of how distinctive organisational resources and capabilities positively affect innovation outcomes. Furthermore, RBV can be employed for firm-level innovation analysis, especially in terms of innovation capabilities and the elements of the innovation process. RBV theory brings with it a useful literature for interpreting the internal dynamics of SMEs. It provides one appropriate lens for analysing internal competence and strategic variety.

3.2 Network theory

Network theory has become a dominant strain in the literature over the last few decades. Network theory is described as "a governance structure" which is based on the economic rationality assumptions underlying business activity, as socially embedded. Network theory argues that business networks—clusters of firms or specialist units coordinated by relationship governance instead of multi-level hierarchy governance or market governance— are better suited than other forms of governance for many of today's demanding environments (Snow, Miles, & Oleman, 1992). Network theory is not only built on the interaction model, but is also integrated with theories in related studies or other disciplines (Easton & Araujo, 1989). In fact, network theory has been applied to the study of innovation management for decades.

The paradigm of a network is a web linkage which can be viewed as a complex interconnected group or system. The network concept has been used as a "metaphor to explain organizational activities" (Park, 1996, p. 797). The network structure is interpreted as "…the organizational forms and processes through which activities are directed in a field" (Håkansson & Johanson, 1993, p. 44). Cook and Emerson (1984) delineate the characteristics of networks as "sets of connected exchange relationships between actors controlling business activities". Firms involved in a wide range of networks and business activities are co-coordinated through interactions that influence and adapt to each other. A network is an expression of a socio-economic framework that can be interpreted in the context of economic, social and relational dimensions

(Edwards, et al., 2005). Both social and economic factors are embedded in the creation and development of networks. The prevalent recognition of networks that are consisted of organised systems of relationships. Szarka (1990, p. 10) states that "a network is generally defined as a specific type of relation linking a defined set of persons, objects or events". Networks can mean connections and interactions among individuals, groups and organisations (Donckels & Lambrecht, 1995; 1997).

A network can be described as a hybrid consensual form; it is typically based upon many dyadic, triadic and multiplex relationships among various people, organisations and companies (Johannisson, 1996). The foundation of the network theory model is based on the scientific assumption that resources are located in different units that lead to dependency and exchanges. Networks exist and are characterised by interdependence and interface among network components broadly classified as "actors", "activities" and "resources" (Håkansson and Snehota, 1990; Håkansson and Johanson, 1992). In the same vein, Laumann et al. (1983) identify three key components in a single network: actors, activities and relations. Accordingly, the basic theoretical archetype of a network is composed of three elements. Actors are the fundamental units in the network who possess or control resources. Activities are associated with transaction contents, links and the flow between different actors. Relationships refer to the nature of dyadic ties and bonds (Conway & Steward, 1998) in terms of "contract agreements", "partnerships" or "strategic alliances". The three elements of network are not entirely independent of each other, but are actually interconnected. In this way, a network consists of various autonomous actors who perform different activities through the use of resources. Networking can offer an explanation of the way that various companies or actors obtain access and exchange skills and resources through the creation of relationships. On the other hand, a network consists of some actor bonds that are the most important elements in the network; fundamentally, it is the long-term relationships between actors that define a network. There are also resource ties between companies which lay the foundation for various activity links.

There are unequal power relations and distinct positions between actors in a network. Some play major roles and have more influence in

shaping the network than others (Kothandaraman & Wilson 2001). A firm's structural position in a network is determined by its own resource control and engagement. Every firm occupies a unique structural position in the network because relationships are inherently asymmetrical (Burt, 1982). One firm possesses resources or can access potential resources more efficiently than other firms, which translates into a better position in the network. More resource-rich firms have dominative power in the central position of a network. Obtaining this position is the result of earlier activities in the network by both that firm and other firms, and constitutes the basis which defines the development possibilities and constraints of the firm in the network (Mattsson, 1985). Network activities primarily involve improving the network position, which can give a company access to resources controlled by others or build strong relationships with other actors. The network is also embedded in a social structure encompassing social relationships between organisations. The position in the network can enhance an actor's ability to maximise benefits from collaboration and to achieve economic goals (Coleman, 1990; Tsai & Ghoshal, 1998). Furthermore, an organisation's network position affects its innovation. Focal firms dominate the central position in the inter-organisation network can easier access to unique sources of information and knowledge, and even hold overwhelming power over the other members (Tsai, 2001). Larger firms may have more power over networks. In contrast, SMEs are often in relatively weak positions with less influence in networks.

The network approach has two key factors in the scholarly context, encompassing trust and long-term commitment. The interactions between SMEs in a network are based on mutual trust and reciprocity. Trust as a governance mechanism in networks influences the establishment of relationships and the level of resource exchange (Tsai & Ghoshal, 1998). Trust is conceptualised as "a willingness to rely on an exchange partner in whom one has confidence" (Moorman, Deshpande, & Zaltman, 1993, p. 82). Trust bonds with different partners may significantly lower transaction costs and costs of supervision (Williamson, 1985) and reduce the level of risk (Burt, 1997). Deeper cooperative partnerships are directly affected by trust (Gardet & Mothe, 2012; Mohr & Spekman, 1994). Lorenzen defines trust as "a cognitive coordination mechanism" (2001, p. 16). Zahra et al. (1999) found that

trust is a necessary precondition for the successful exploitation of entrepreneurial opportunities. Strong trust increases collaboration and reduces the need for control. Building trust through interaction takes time. Uncertainty in a network is reduced by trust. Madhok (1995) argues that trust is built on the basis of mutual expectations comprised of reciprocity and that it coordinates action. In fact, SMEs that have higher degrees of trust in their cooperative partners are more likely to engage in networking (Wincent, 2005). Commitment is another key concept and can be described as mutual dependency in which partners make efforts to maintain a valuable relationship (Morgan & Hunt, 1994). Commitment is also concerned with the extent of engagement in combining resources between actors, "relationship commitment as an exchange partner believing that an ongoing relationship with another is so important as to warrant maximum efforts at maintaining it" (Morgan & Hunt, 1994, p.23). Networking takes time and resources to build strategic relationships, especially harmonious relationships that require a high level of trust, communication and commitment.

SMEs are increasingly required to be innovative in order to confront technological obsolescence and market changes. The process of innovation may require a substantial resource commitment. SMEs are inherently resource-constrained in finance, skilled labour, technology, information and other areas. Therefore, SMEs are facing the challenges in innovation involving resources and capabilities. Furthermore, SMEs are more likely to lack innovation networking than larger firms in terms of science and technology transfer. SMEs usually make limited use of networks for innovation. The fact is that no single firm can innovate in isolation and the process of innovation is not conducted simply within an individual company (Mohannak, 2007). Innovation requires greater resources and sufficient capabilities to manage and organise the entire innovation process. Essential innovation resources are embedded in a network and not in a firm alone (Afuah, 2003). Innovation for SMEs is becoming more difficult and complex (Diez, 2000). Shan et al. (1994) argue that the various cooperative relationships in a wide range of networks are more important to innovation.

Networking is a key factor in speeding up innovation by providing access to specialised knowledge and resources. Moreover, innovation is also recognised as an interactive process both within firms and with

other entities (Tödtling & Kaufmann, 2001). Tether (2002) notes that having multiple types of partners can offer a different set of resources for the innovation creation process, such as suppliers, customers, universities, research institutes and other associations, which can all support a firm in its innovation activities. An array of recent studies have demonstrated that innovation is significantly correlated with networking; more innovative firms have more diverse ties than firms that innovate less (Baum et al., 2000; Powell et al., 1999). SMEs need to gain external sources of information, knowledge and technology to strengthen their innovation capabilities; collaboration with other firms or institutes is absolutely necessary (Edwards et al., 2005).

Network theory provides researchers with a new way of examining and understanding SME innovation phenomena. Recent empirical research on networks and innovation has shown that networking and inter-organisational collaboration are of utmost importance for firms in their innovation processes (Freeman, 1991; Tether, 2002). A network is particularly important for SMEs. Firms engaging in networks are more successful at innovation than isolated firms (Ahuja, 2000; Powell et al., 1996; Powell & Grodal, 2005).

The typology of networks: Based on Mitchell's (1973) and Johannisson's (1987) network classifications, Szarka (1990) distinguishes the typology of networks as three forms. The first are exchange business networks, which consist of a firm's supply chain or commercial relations with suppliers, distributors, customers or competitors. The second are communication networks, including the organisations and individuals that provide a firm with the contacts and knowledge that inform its business activities. These might constitute industry bodies, local and central government agencies, consultants and advisors (Szarka, 1990, p. 12). The third form are person-related social networks (Gulati, 1998; Gulati et al., 2000) involving different family or other personal relationships. It is a broader informal network formation comprised of relatives, friends and acquaintances, based on trust, or other individuals who have shared cultural values, norms and beliefs. Personal social networks are directly linked to many other individuals and organisations.

Strong ties and weak ties: Through network theory, we can understand how SMEs use external networks and actors to facilitate

innovative activities. Each specific relationship is unique and composed of a number of different interdependencies and links. According to the quantity and intensity of the interactions or links between actors, networks can be classified into strong ties and weak ties (Granovetter, 1973; 1985). Strong ties are characterised as intense relationships in which partners have close connections with one another. The common goal pursued in the relationship is not necessarily found within the relationship itself but may be found in a network of connected relationships (Anderson et al., 1994). With strong ties, interdependence is high and relationships are tight, with formal structures and reciprocity. Those relationships are considered solid, strategic and long-standing relationships. Formal relationships promote information exchange, knowledge sharing and interactive learning among cooperating partners. Strong ties ensure effective innovations by encouraging knowledge transfer and diffusion among member firms, especially codified and tacit knowledge. Strong ties are more likely to enhance the depth of knowledge and technologies. By contrast, in weak ties, the connections among members are very loose, informal and temporary with arm's-length or transient relationships. But weak ties provide firms with more diverse information, rich links to novel ideas, new business contacts and opportunities (Johannessen, 2001). Weak ties can increase the diversity of knowledge and expertise as well as sources of inspiration, which are beneficial for exploration. Normally, new breakthrough innovations are created by a diverse network of weak ties (Freel & de Jong, 2009). Indeed, strong ties and weak ties are both important for a firm's ability to innovate, since they function differently (Lechner & Dowling, 2003).

The dynamic nature of networks: Networks consist of a substantial number of member firms that are engaged only on the basis of their own firm's level of interest in the network's activities. Newman (2003) delineates that networks enable the addition of new links and new nodes with resilient and evolutionary features. Networks display a high degree of complexity, and relationships can change over time. Relationship development is based on common interests and objectives that involve parties who have mutual expectations of respective contributions and benefits (Blankenburg-Holm, Eriksson, & Johanson, 1999). Sustaining partnerships takes time, and they are developed step by step. The

makeup of any network is not fixed but fluctuating, a set of inherently unstable relationships between actors. The cooperative form is also genuinely dynamic, as firms cooperate with one another to exchange ideas, knowledge or resources; all while maintaining independence in other areas (Rosenfeld, 1996). The structure of any network is constantly in motion and progressing, being modified and restructured through interactions.

Network ties are related to innovation and technical advances (Håkansson, 1987). From the network perspective, innovation can be seen as an exchange, adaptation and interactive process; it also entails interactive learning. Innovation activities are positive associated with learning interactively and communication sufficiently (Håkansson & Sneota, 1995). Yli-Renko, Autio and Sapienza (2001) investigated young high-tech SMEs, noting that networks provide opportunities for potential learning, so that firms are able to use knowledge acquired from partners to enhance their own technological distinctiveness.

The innovation efforts of SMEs are strongly linked to networking and collaborating with other organisations (Keizer et al., 2002). Networks create synergy and opportunities for SMEs to develop more significant and higher levels of innovations through combining complementary know-how from a variety of organisations (Gulati, 1999). Inter-organisational collaborations reduce transaction costs and generate value-added activities. Networking for innovation purposes increases innovative activities by bringing external sources into internal innovation processes. Networks as conduits provide SMEs with access to the complementary resources, knowledge and information that are necessary to develop a sustainable competitive advantage. Collaborative relationships have a significant impact on innovation outcomes (Ahuja, 2000). In sum, networks offer strong opportunities for increasing sales volume or profits in an alliance relationship, gaining resources or access to new markets or jointly developing innovations (Ritter & Gemünden, 2003; Walter et al., 2001). A network of innovation involves a variety of actors (e.g. suppliers, customers, competitors, government agencies, consultants, universities and research organisations, industrial associations and trade organisations) those actors impact and interact in SME innovation process (Conway & Steward, 1998). The most influential actors are customers and suppliers (Perez & Sanchez, 2002; von Hippel,

1988). Cooperation along the vertical supply-chain can improve the innovation process among SMEs (Tomlinson & Fai, 2013). Arguably, close contact with customers helps firms gain access to new knowledge, information and advice, thereby increasing their technological competency and competitiveness (Hoffman et al., 1998). Universities and research institutes as knowledge-generating actors are the primary contributors of the latest technology and scientific knowledge. Collaboration with universities or research institutes enables firms to exploit more advanced innovations (Lasagni, 2012), which is particularly beneficial for high-technology enterprises. Government bodies establish the legislative infrastructure and institutional policies that stimulate innovation in SMEs, such as subsidies for innovation and R&D funding or public services. External consultants can provide consultations, training and specialised technical, managerial or marketing knowledge to firms. Professional associations create the potential of new ideas development and exchange for those members from different industries and sectors, which can facilitate the sharing of both tacit and explicit knowledge.

Appropriate benefits from networking: SMEs use network actors to generalise ideas and knowledge in their innovation processes. Ahuja (2000) argues that a firm is involved in multi-fold networks, acting with different actors who can affect its innovation output positively as follows:

1. Knowledge sharing. Innovation processes require the simultaneous input of different types of knowledge. Inter-firm connections can facilitate the exchange of knowledge, which is a key element in innovation success (Berg, Duncan, & Friedman, 1982). In other words, the generation of knowledge is through collaborative relationships with partners. Essentially, a firm's network position reveals its relative strength in gaining access to new knowledge and absorptive capacity (Cohen & Levinthal, 1990) and reveals its ability to assimilate, apply and exploit such new knowledge (Tsai, 2001).

2. Complementarity. Collaborative ties can lead to the pooling of complementary skills and technologies from various organisations (Arora & Gambardella, 1990; Powell et al., 1996). An innovative company typically needs complementary assets and competencies.

3. Economies of scale. Collaborative projects enable firms to achieve the advantage of scale economies in research rather than costly individual R&D investment. Larger co-operative projects can produce significantly more knowledge than smaller projects (Ahuja, 2000).

Nevertheless, networks may have negative effects, as they do not always bring synergistic benefits to member firms. There are some risks in networks for which membership firms should be on the lookout, such as opportunism, free-riding, "lock-in" and inter-firm conflicts. Opportunistic behaviours occur in strategic SME networks when each of the participating firms acts in its own self-interest. Free-riding on new technology or information may occur when operating with partly independent members who are unwilling to invest (Human & Provan, 2000; Wincent, 2005). Lock-in involves network inertia caused by member firms that are overly dependent on each other within a narrow relationship. It a vicious circle that interlocks member firms into low-productivity processes that can lead to inefficiency, less flexibility and the waste of tacit knowledge and other resources (Arthur, 1989; Huggins, 2010). To avoid those situations, networks should remain open to new or potential partners, keep interests harmonised, build mutual trust and deliver equitable benefits. Meanwhile, it is also necessary to constantly reconfigure and reconstitute inter-firm relationships, adding new ties and cutting old ones. Additionally, previous research suggests that firms should reduce dependency on others by relying on network partners only for simple tasks and limiting reliance on others for core capabilities (Fine & Whitney, 1999). In order to minimise the risk of over-dependence on larger, more powerful firms in the network, SMEs should invest in building up their own internal innovation resources and capabilities.

3.3 Entrepreneurship orientation theory

Innovation and entrepreneurship are closely connected (McFadzean, O'Loughlin, Shaw, 2005). The nature of innovation is fundamentally about entrepreneurship (Bessant et al., 2007). As such, when undertaking SME innovation research, we must also consider entrepreneurship thoughtfully. Schumpeter (1934) views the entrepreneur as playing an initiator role in the process of innovation. Entrepreneurship has been called the "parent of innovation" (Meyers, 1986). Similarly, Drucker (1985) considers innovation to be a core indication of entrepreneurship and sees entrepreneurs as innovators who make innovation happen. In his book Innovation and Entrepreneurship,

Drucker describes innovation as "the specific instrument of entrepreneurship" (p. 30). He adds that innovation is a specific tool for entrepreneurs to exploit different opportunities. Schumpeter (1939, pp. 69–70) notes that entrepreneurs produce innovation and contribute to the growth of the economy.

Entrepreneurship is not narrowly referred to the special traits of the individual entrepreneur. It is a psychological merit that typically embraces dynamism, creativity and originality. Entrepreneurship generally entails the combining of resources to create new ways of acting (Schumpeter, 1934). Similarly, Shaver and Scott (1991, p. 39) state that "….create a new venture, for that we need a person, in whose mind all of the possibilities come together, who believes that innovation is possible, and who has the motivation to persist until the job is done…". When investigating innovation in the SME context, we must focus on the attitude and behaviour of entrepreneurs who shape specific organisational strategies and actions. Innovation strategies often associated with entrepreneurial behaviour are considered as one of the most promising paths to corporate growth (Cooper, Woo & Dunkelberg, 1988; Covin, 1991). Theoretically, entrepreneurial orientation has a close connection to innovation literature (Lumpkin & Dess, 1996).

Entrepreneurial orientation (EO) is widely viewed as a core concept in the field of entrepreneurship studies. It is an apparent proclivity of top management (Covin & Slevin, 1989; Lumpkin & Dess, 1996; Miller, 1983). Danny Miller (1983) introduced the dimension of EO to the strategic management and entrepreneurship literature. Miller (1983, p. 771) posits that an entrepreneurial firm as "one that engages in product-market innovation, undertakes somewhat risky ventures, and is first to come up with 'proactive' innovations, beating competitors to the punch". EO denotes an organisational-level entrepreneurial style which is one of the attributes of corporate entrepreneurship (Covin & Lumpkin, 2011). Miller conceptualises EO as highlighting three dimensions of firm-level entrepreneurship: proactiveness, innovativeness and risk-taking (Miller, 1983; Miller, 2011; Rauch et al., 2009). These dimensions are the salient characteristics of entrepreneurship, which are the central attributes of EO, and are also related to the objectives held by CEOs (Covin and Slevin, 1986; 1989; Miller, 1983). Moreover, EO is a firm-level strategic approach (Venkatraman, 1989), which can be viewed as the processes,

practices, and decision-making activities of an innovator firm (Lumpkin & Dess, 1996). The concept of EO has proven validity and is widely accepted in the academic literature (Covin & Lumpkin, 2011; Lee et al., 2001). It helps us to understand why some small firms can realise sustainable renewal and maintain competitive positions. Proactiveness involves "first-mover" actions, anticipating future market needs and changes, pursuing perceived opportunities and taking the initiative in response to emerging markets (Covin & Slevin, 1989; Kreiser et al., 2002; Lumpkin & Dess, 1996). A proactive firm can create first-mover competitive advantages through initiatives that seize new market opportunities and pioneer new products and services to the market place. Risk-taking is concerned with an entrepreneur's attitude towards uncertainty, a willingness to take bold actions or to invest in risks, encompassing social, personal, psychological and strategic risks (Runyan et al., 2008). A high risk tolerance is one of the most important characteristics of entrepreneurship. An entrepreneurial firm therefore tends to take risks to obtain superior returns or profitability by exploring and exploiting business opportunities in the marketplace (Lumpkin & Dess, 1996). Innovativeness refers to a firm's commitment to novelty, experimentation and R&D activities that are aimed at facilitating creative processes that lead to new products or services, or new technological processes (Lumpkin & Dess, 1996). Innovativeness entails a firm's propensity to challenge the status quo and engage in innovation activities, so as a key sub-construct of EO. In "Schumpeter Mark I", Schumpeter (1934, 1942) points out that innovation is generated mainly by entrepreneurial activity. Innovativeness has become a significant factor by which to characterise entrepreneurship, and this notion has been widespread and utilised by researchers to portray entrepreneurship (Miller & Friesen, 1982; 1983; Zahra & Covin, 1995).

Entrepreneurial orientation appears to have a correlation with environmental conditions and firm performance. EO is positively related to a dynamic environment (Miles & Arnold, 1991). Khandwalla (1987) argues that when firms have an entrepreneurial orientation that includes risk-taking, innovativeness and proactiveness, they can cope successfully with uncertain conditions or when competing in turbulent or hostile environments. In a similar vein, most researchers confirm that EO can enhance firm growth and performance by increasing a company's

proactiveness and risk taking, as well as innovations in product, process and service (e.g. Lumpkin & Dess, 1996; Zahra, 1993b, Zahra et al., 1999). Particularly, the relationship of EO to performance is demonstrated as more significantly in highly dynamic and intensely competitive markets (Zahra & Covin, 1995). Furthermore, Wiklund and Shepherd (2005) discovered that EO has a positive impact on small business performance. Similar evidence of the positive relationship between EO and performance has also been found in China (Tang & Tang, 2010, Zhao et al., 2011). Accordingly, EO has become critical in explaining SME innovation. EO can be described as a firm's strategic stance in relation to the decision-making processes. It implies that a firm's entrepreneurial posture involves boldly pursuing new market opportunities and proactive market competitions (Covin & Slevin, 1991; Lumpkin & Dess, 1996). A firm with high EO will demonstrate a high level of innovative behaviour and take aggressive action toward competition. EO reflects the top managers' overall philosophy regarding an entrepreneurial attitude to innovation practices. The EO construct is associated with innovativeness and entrepreneurial strategic vision, and contributes to SME growth and development (e.g. Moreno & Casillas, 2008, Rauch et al., 2009).

In addition, EO can be viewed as the entrepreneurial strategy-making processes (Pérez-Luño, Wiklund &Cabrera, 2011). Some researchers use effectual approach to explain the behavior of entrepreneurial firms in transforming environments since Sarasvathy introduced effectuation theory (2001). The current effectuation studies argue that entrepreneurs focus on what they can control on the basis of their own knowledge and resources, deploying the means to transform or shape the environment (Sarasvathy 2001). Wiklund and Shepherd (2011) extend EO theory by addressing two perspectives, which are "EO-as-advantage" and "EO-as-experimentation". They note that "EO-as-advantage" pertains a positive outcome when the firm pursuing EO, and "EO-as-experimentation" implies various EO outcomes are associated with both failure and success (Wiklund and Shepherd 2011). Mthanti and Urban (2014) examined the relationship between effectuation and EO. They found that the three dimensions of EO are conceptually linked each to effectuation. An innovative entrepreneurial firm proactive use effectual strategies to transform or shape the environment, resulting in the firm with a

competitive advantage. They further argue that there is strong alignment between Effectuation and the firm's level of EO. Effectuation is a moderator that may impact on the EO-performance relationship (Mthanti and Urban, 2014).

In small- and middle-sized firms, entrepreneurs or small management teams run the business. The role of entrepreneurs in fostering innovation is of utmost importance. The success of SME innovation lies in the ability of top managers to make the correct decisions and take the appropriate actions, encouraging new ways of thinking and rewarding new ideas within the company. Tan (2001) notes that transitional economies offer more opportunities for firms, revealing that private Chinese entrepreneurs show a strong tendency for EO and are willing to take higher risks and more bold innovations. In this respect, EO offers a very helpful theoretical approach for understanding the entrepreneurial strategic orientation in Chinese SMEs, and is especially well-suited to explain SME innovation activities.

3.4 Integration of the three theories in the study

The relevance of innovation in gaining and maintaining enterprise competitiveness has been broadly discussed in the managerial literature (Freeman, 1997; Mowery and Rosenberg, 1989; Nelson and Winter, 1982; Porter, 1988; Rosenberg, 1976; Tidd et al., 2001). It is often argued that SMEs innovate in specific ways that differ from those of large firms. The innovative advantages of large firms are in the form of available materials and resources and formal innovation processes, while small firms are attributed with behavioural advantages (Rothwell, 1985) and an entrepreneurial orientation. Drawing upon literature from various fields, the present study strives to integrate and extend a theoretical stance that draws from the RBV, network and EO theories. Although each theory has its specific focus, they are all considered useful in research into SME innovations from different preservatives.

RBV theory brings an internal analytical tool to interpret SME innovations. It can help us to identify the key elements of innovation process in SMEs. According to RBV theory, an SME pursues the innovation strategy that best fits its unique endowments. SME

innovation behaviours are thus especially related to internal knowledge, capabilities, resources and skills that they possess. Habbershon et al. (2010) comment that RBV theory and EO literature are generally interlinked. A firm's long-term entrepreneurial orientation is supported by its available resources and capabilities. A firm that has a strong EO is more likely to access networks to seek resources and information or exploit growth opportunities (Johannisson, 2000; Wiklund et al., 2009). SMEs are often restricted by limited competencies, inadequate knowledge and scarce financial resources, which make it difficult for them to overcome their limitations and develop innovations. Therefore, innovation through networks is a strategic way for SMEs to overcome their disadvantages. Collaboration enables SMEs to improve their innovative performance and competitiveness by integrating their partners' assets and expertise.

In this study, the conceptual framework of a small firm's general innovation model is constituted of internal and external processes and linkages. This model is formulated on the basis of integrating the studies of Brown (1997) and Gemünden, Ritter and Geydebreck's (1996). Brown (1997) provides an innovation audit model and internal innovation management tools to examine a firm's innovation processes. According to Gemünden et al. (1996), the various external actors perform different roles in the network. They can all be regarded as supporting actors that affect a firm's innovation activity. The integrative conceptual model is illustrated in Figure 6, and includes:

1) The innovation process inside a small or middle-sized firm consists of three processes: strategy process, primary innovation process and learning process.

2) The interactions between key suppliers and lead customers in the vertical supply chain.

3) The innovative knowledge contributed by the major innovation actors including universities and other academic institutions. Universities and research institutes are responsible for providing new knowledge

4) The interaction between trade or industry associations and professional consultants or consulting companies.

5) The support from government agencies and financial institutions. Financial institutions are responsible for capital and loans and

government agencies are responsible for innovation policies and industrial regulations.

6) The collaborative innovation with other partners, both organisational and individual actors, based on complementary relations.

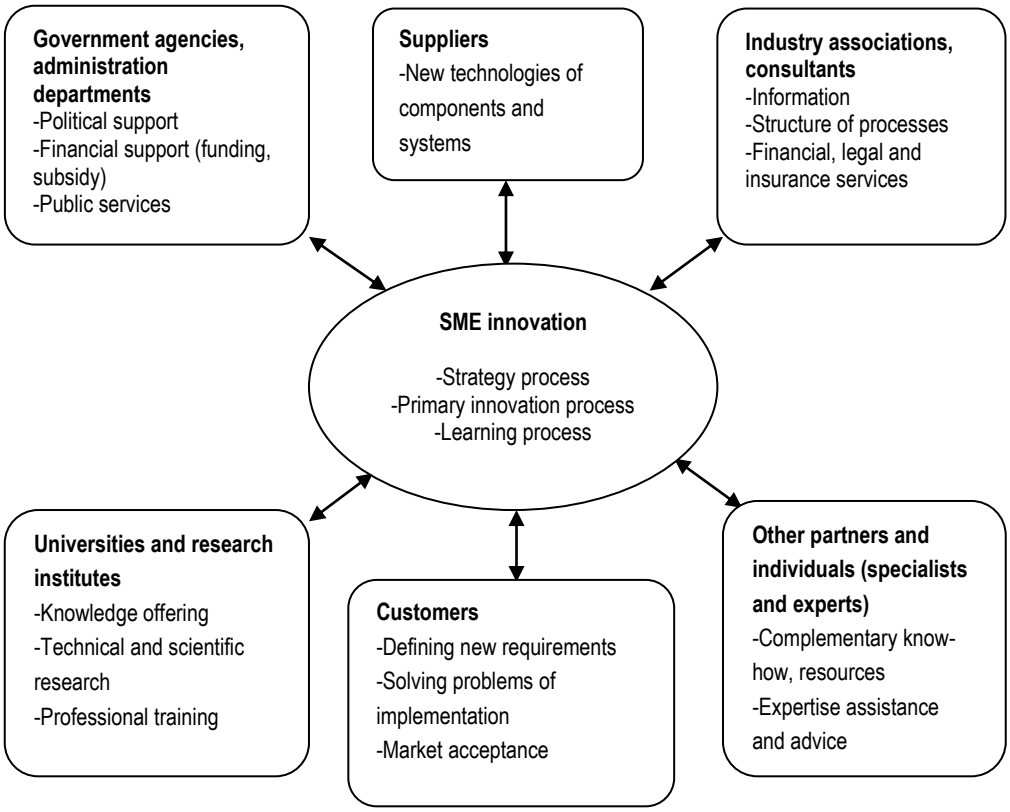

Figure 6. An SME's generic innovation model, adapted from Gemünden et al. (1996, p. 450) and Brown (1997, p. 243).

An innovative SME involves selecting collaboration networks and cooperating with various actors in the innovation process. Capability can be acquired by absorbing relevant skills and knowledge from outside, fostering new connections, expanding the firm's search scope and increasing the speed and quality of learning from external sources (Zahra & George, 2002; Mowery et al., 1996). A firm can enhance competitive advantages through the bundling and synergistic merging of other organisations' resources (Black & Boal, 1994; Galunic & Rodan, 1998;

Teece et al., 1997). Nooteboom (1994) confirms that SMEs can obtain advantages and overcome internal resource constraints by exploring networks. Therefore, networking is particularly important for an SME to increase its innovation output and competitiveness (Pittaway et al., 2003; Powell et al., 1996).

Innovation is regarded as a process which results from various direct or indirect and informal or formal interactions among different actors (Doloreux, 2004). It appears to rely on specific knowledge sources and links. Therefore, the development of innovation is no longer isolated or separated, but increasingly demands cooperation across organisations (Chesbrough, 2003). External relations are important for the innovation activities of SMEs in terms of gaining access to resources and obtaining specialised knowledge. A network of inter-unit connections provides channels to distribute information and knowledge acquisition in such a way as to stimulate and support innovative activities. The traditional linear model of R&D as the basis of innovation through to commercial ends is thus shifting to a model with a wide network of sources and partners integrating complementary competencies (Xu et al., 2012). Becker and Dietz (2004) explicitly note that cooperation with different partners on research and development has a positive effect on innovation achievement. Networking with science partners can reduce R&D technology times and costs. Sustained innovativeness depends on each firm's set of dynamic capabilities through which the firms gradually access, assimilate and utilise innovation-related knowledge that is generated by outside sources. In the same vein, Gemünden et al. (1996) found that the degree of innovation success is positively related to a firm's technological network, depending on multifaceted cooperation with diverse actors. In addition, many empirical results indicate that most radical innovations are created within networks that embrace a variety of significant sources to produce synthetic solutions (Chang, 2003).

Compared to large firms, SMEs may rely much more heavily on external networks as a source of input for their innovations (Rogers, 2004). Networks are valuable because they provide the opportunity for an SME to obtain new capabilities. Innovative SMEs must always remain aware of the importance of different partners in networks, getting close to customers to understand their needs, working with suppliers to

develop innovations ideas and solutions; linking up with collaborators, academic institutions and other complementary actors to obtain heterogeneous resources; and through direct or indirect ties to gain access external financial resources and government funding. The resource-based view of firms suggests that in order to acquire the assets necessary for survival and competitive advantage, they seek out resources from both the environment and other firms (Eisenhardt & Schoonhoven, 1996). Those extensive links may lead to resource exchange, organisational learning, innovation success and strategic renewal (e.g. Fukugawa, 2006; Lipparini & Sobrero, 1994; Wincent, 2005).

The locus of innovation is not the output of independent decision-making at the firm level. It can be seen in networks rather than in individual organisations or individual employees (Pittaway et al., 2004). The flow of innovation has been interpreted as an interactive, on-going and cooperative process of intra- and inter-firm links. Interactive models of innovation stress the importance of continuous cooperation between the actors involved in the innovation process, such as forward and backward connections at all steps of the innovation process (Kline & Rosenberg, 1986). Firms should enable the building and utilising of network relationships to gain competitive strength (Ritter, 1999) and thus to achieve their innovation goals.

SMEs are increasingly encountering challenges in terms of the complexity of technologies, rapid knowledge evolution and shorter product life cycles. Innovation through networks creates a novel concept in which firms seek R&D partners with complementary capabilities or knowledge (e.g. Mowery et al., 1998). SMEs may benefit from networks by acquiring new technology, sharing R&D costs and reducing risks. SMEs utilise networks and external actors differently depending on the type of innovation involved (Freel & de Jong, 2009; Varis & Littunen, 2010). Radical innovations are likely to require the involvement of more network partners than incremental innovations.

Vossen (1998) confirmed that small and large firms are in a complementary relationship. Collaborating with large firms may allow small firms to take advantage of scale economies. Network ties help SMEs to make better use of available resources from outside and make them better positioned in terms of their ability in innovate successfully

(Laforet, 2011). Diversity in ties may bring SMEs superior access to important ideas and the most promising opportunities. To be successful and coexist with large enterprises, small firms must possess distinctive assets and capabilities.

SMEs should recognise the importance of using networks as a development and innovation tool (Freel & de Jong, 2009). SMEs in strategic networks are better equipped to build competitiveness. Here, the success of innovation primarily requires access to assets that are complementary to the innovative assets (Teece, 1986). It is important to determine which types of partners a firm could cooperate with, and how to use those relationships to support innovation.

Innovation can be generated inside of a firm, but most sources of innovation usually reside outside of firms (Powell, 1990). External sources are important input to SME innovation processes. Through extensive connections with external partners such as suppliers, customers, competitors, universities, and public entities, a firm's ability to innovate will eventually be increased (Tödtling, Lehner, & Kaufmann, 2009). In a certain sense, SMEs need to involve themselves in multi-firm networks to extend their knowledge bases, obtaining innovation-related ideas and information and entering new markets. Human and Provan's (1997) definition of strategic SME networks acknowledges that firms in strategic SME networks cooperate with one another in exchanging ideas, knowledge, resources and even marketing. SME networks are generally comprised of three identifiable dimensions: purpose, inter-dependence and membership criteria (Human & Provan, 1997). Social ties or networks are regarded as important vehicles for exchanging and transferring information or knowledge in the SME context (Huggins and Johnston, 2010; Uzzi, 1997). A relationship approach to innovativeness will lead managers to look at both their own and other resources, and thus to make innovation decisions strategically. Briefly, the network has become indispensable for SMEs wanting to carry out strategic innovative activities successfully (Zeng, Xie, & Tam, 2010). SMEs can acquire a wider variety of external ideas, information, knowledge and resources by participating in an SME network than by going it alone.

To sum up, nurturing and organising innovation is a challenging task, especially in networks of collaborating companies (Cormican & O'Sullivan, 2004). In order to gain competitive advantage in today's

dynamic business environment, SMEs need to establish and enhance their network competence, integrating external sources into their internal innovation processes (Rammer, Czarnitzki, & Spielkamp, 2009). SMEs must first engage in collaborative networks that can aggregate pools of complementary resources and competencies. SMEs ought to import or acquire the technology they need from outside via joint ventures, strategic alliances or partnerships. SMEs should find different kinds of partners in the extensive innovation process. Firms can use inter-firm collaboration to gain skills and information and to obtain external resources, thereby helping to establish their own innovation capabilities. SMEs should be involved in formal or informal collaborative or partnership arrangements with external organisations, identifying and building trust with key partners and actors in a network. The collaborating parties need to dedicate resources to managing and coordinating the innovation process in a mutually supportive way. Innovative-oriented relationships need to be managed effectively and efficiently. SME networking requires the management of synergies and co-ordination of all relationships, such as promoting strategic alliances with customers and suppliers, and simultaneously facilitating dynamic ties with other actors. Developing a mixed set of inter-organisational ties (strong versus weak) may be useful for SMEs to maintain novelty, creativity and flexibility. Finally, innovation is an interactive learning process based upon cooperation and mutual trust. SMEs need to seek out and amass a collection of innovation-related assets and skills and cooperation in innovation partners by trust-based, long-term commitment. Because a higher degree of technology creation and transfer in innovation networks required mutual trust (Pérez & Sánchez, 2003), a lack of trust will impede knowledge exchange and resource-sharing across innovation networks.

There is no doubt that the network has now been established as a platform for cooperation between SMEs and partners in order to exchange resources and achieve mutual learning. The most important task for a firm is the integration of, and interaction between network actors or partners in order to accelerate innovation processes and achieve successful innovations. To avoid the risks of opportunism or short-term orientation in an SME network, collaborators should be

chosen who can provide complementary resources for the relevant innovation in a win–win mechanism.

In short, innovation is clearly an imperative that determines a firm's sustained competitive advantage. The essence of innovation management lies in the ability to continually enhance an organisation's knowledge, based on creating new products, processes, systems, business models and methods. For SMEs, innovation management requires an understanding of its characteristics. Network literature, EO theory and RBV offer three theoretical pedestals that combine to offer new angles of looking at SME innovation. The present study attempts to link those theories symmetrically. RBV pays attention to the internal resources in an "inside-out" approach, network theory emphasises different aspects of external relations and complementary resources in an "outside-in" approach, and EO theory suggests that a good entrepreneurial firm is able to understand the changing business environment and assess its own resources and capabilities correctly. On the one hand, prior studies have demonstrated that SME networks significantly improve SME innovations. SME cooperation in innovation is considered necessary. SMEs must become more aware of the fact that networks can offer opportunities to strengthen the core competencies in today's economic environment. On the other hand, resources and capabilities can help SMEs to compete in the long run. The primacy of strategic innovation is also based on firm-specific abilities to deploy the appropriate external and internal resources. Furthermore, a set of key factors related to networks are directly related to an SME's development of competitiveness. A deeper understanding of RBV, network and EO theories will be valuable in generating linking knowledge of SME innovation. In the following chapters, I apply these theories in my data analysis.

4 RESEARCH METHODOLOGY

Methodology is defined as a significant scientific means of knowledge creation and refers to a set of methods or techniques that can be applied in conducting research. It is concerned with how we come to know of the world. Methodology also builds a bridge between theory and reality, playing a crucial role in determining the validity and reliability of any study. Ontology is concerned with philosophical assumptions about the nature of world, the actual forms of reality. It can be separated into objectivism or subjectivism, and many other positions. My study takes an objectivist approach. My ontological assumption about reality is that it is objective and independent of humans as observers or subjects. Phenomena are beyond our research. Epistemology is defined as a philosophical position concerning the nature of knowledge and the relationship between the researcher and what is studied. It is especially associated with validation and the methods used. My epistemological stance is post-positivism. "Post-positivism" is one of epistemological positions that refers to the thinking encouraged after positivism (Guba, 1990). A post-positivist believes that knowledge is developed on the basis of careful observation and the measurement of an objective reality. We can understand the world by using scientific methods to test, verify and refine our theories. Nevertheless, knowledge established in research is always imperfect and has some bias (Creswell, 2003). In short, with respect to my ontological and epistemological assumptions, reality can be known by employing scientific approaches that generate some acceptable knowledge.

4.1 Research paradigm

A paradigm is a bundle of assumptions about the nature of reality. It provides an overall view for us how to look at reality. The operational paradigm is a bridge between methodological views and the study area. A

paradigm is defined as "a cluster of beliefs and dictates which for scientists in a particular discipline influence what should be studied, how research should be done, [and] how results should be interpreted" (Bryman, 1988a, p. 4; Bryman & Bell, 2011, p. 24). Different types of methodological approaches distinguish themselves from others in terms of paradigm. According to Katz and Kahn (1966), systems thinking provides a useful paradigm for organisation and management researchers to study the complexities of "live" organisation. In systems thinking, phenomena no longer occur in isolation, but involve organisations operating under varying conditions and in specific circumstances. The systems paradigm views the whole as not simply equal to the sum of its individual parts, seeking to interpret the synergistic effects. The various bundle components are comprised of system environment, with the main objective of maintaining structure. Knowledge is developed on the basis of interpreting one or several types of system or specific system phenomena.

This study presents a system framework for characterising the generic difference in innovation paths. The innovation phenomenon of SME cannot be understood solely from one perspective. In order to highlight the research problems and to find the correct way to achieve the research goal, the systems approach was then chosen for this study because its systems view offers the best understanding of the big picture of various aspects of the phenomenon. The systems approach is a proven methodology in which viewing specific parts or elements can be combined to create a whole that is greater than the sum of its individual parts or functions. In a systems approach, the world consists of systems, and each system is interconnected. Various types of systems behave in different internal and external environments. Internal and external systems have relationships with one another with synergistic effects. Hence, the specific world is seen as more or less the sum of its parts. Knowledge is unique in the systems approach, qualitative, and generated to explain the unique system model and its particular type of cohesion. The systems approach seems particularly suited to the theoretical perspective of the present study and relates well to its research questions. Using the systems approach enables me to think systematically, comprehensively and dialectically and to take an integrated view of the research topic.

In my research paradigm for this study, reality is related to firms, markets and the business environment, which are seen as a system comprised of numerous components and relationships between these components. In this view, reality is not so much individual acts but complex and organised patterns of ongoing actions. It is a mutual interaction and interdependent set of circumstances. I take into account the relevant relationships between companies and their surroundings. In addition, this study of innovation management is based on objective assumptions, meaning a view of the market and business world as areas that can be explained to a meaningful degree. Reality is looked at from the systematic point of view, and the parts are explained through the characteristics of the whole, thus making it possible to view the business environment as objectively verifiable. In other words, my assumption of knowledge-building is that it moves toward an objective end that reflects the business phenomenon. A conceptual research roadmap will be introduced that consists of several milestones by which to interpret the major ideas of this doctoral thesis. My operative paradigm is demonstrated in Figure 7.

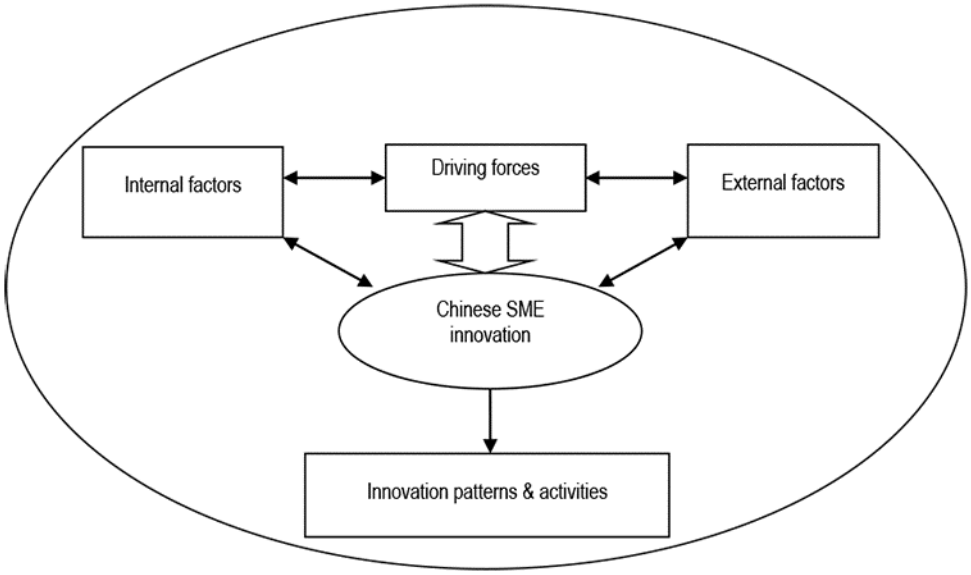

Figure 7. The operative paradigm of this study.

A clarified research paradigm has been established to address the research questions. My operative paradigm is based on systems thinking. I view Chinese SMEs as existing in a specific phenomenon that includes business environment or markets. They are part of a complete system. I describe components of the system and address their relationships with one another in the entire reality system.

4.2 Qualitative case study method

Methods are specific research techniques. As a group of research techniques (Bryman & Bell, 2011), qualitative research is best suited to exploratory studies, especially those looking at a particular topic in great depth. Qualitative research designs tend to work with a relatively small number of cases. This approach helps the researcher to discover the interrelationships among the various components of the phenomenon under study. Qualitative data is based on meanings expressed through words. It can often provide a deeper interpretation and reflection of phenomena than a quantitative approach. Data analysis in qualitative research is conducted by utilising conceptualisations. While qualitative research obviously takes a more unstructured approach, it must have guidelines in order to explore research questions responsibly. Qualitative research offers great flexibility in terms of data collection. Qualitative data may help to explain some particularly thorny questions or issues, and is especially useful in finding a posteriori explanations (i.e. answers to the question "why?"). Qualitative methods are now widely used in business and management research (Eriksson & Kovalainen, 2008). It is useful for more complex and sensitive issues. In small business research, challenges include the validity of existing measurement tools and the fact that some innovation theories developed to understand large firms are not suitable for application to small businesses. My research goal is to obtain a more fine-grained view of various aspects of the underlying phenomena, to gain a deep insight into innovation behaviours within the SME sector. By considering the particular characteristics of SME innovation research, this study is better conducted with qualitative research (Shaw, 1998). This approach should help to discover in depth how and why particular research questions on SME innovation

behaviours will be answered. The choice of methodology enables me to specify the overall research design and address the research questions.

The most common qualitative research methods used in business and management are case study research, action research, grounded theory and ethnography (Myers, 2009). The case study was introduced as a research technique for generating and testing theories many years ago (see e.g. Burgelman, 1983). As a common research method, case study has been widely used in a variety of studies. According to Yin (1981; 1984), the case study is recognised as one of the primary research instruments in qualitative research. Gibbert, Ruigrok and Wicki (2008) argue that the case study is a suitable approach that can be used to probe specific research domains. Yin (2009) further states that the case study research method is valuable in an empirical inquiry that investigates a contemporary phenomenon within its real-life context, suggesting that the case study research method can disclose real-life situations, issues and problems. As distinguished from survey-based research, case studies target specific research focal points and offer more detailed analysis. They facilitate a deeper investigation of contemporary phenomena by asking research questions in the form of 'why' or 'how' (Woodside, 2010; Yin, 2012). The case study approach is helpful in interpreting particularly complex phenomena either by learning something about the case itself or by using the case to achieve a more general understanding (Stake, 1995; Yin, 2009). It is a triangulated research strategy that involves data, investigators, theories and even methodologies (Feagin, Orum, & Sjoberg, 1991).

As a qualitative research strategy, the case study is suited to creating managerially relevant knowledge (Gibbert et al., 2008), has been extensively used in business and management studies, and is especially applicable for new theory development (see e.g. Eisenhardt, 1989). Case studies can be divided into explanatory or causal case studies, descriptive case studies and exploratory case studies (Yin, 1990). Case study research is a common qualitative research method because of its central advantages. It is a type of in-depth research tool that is best used for exploratory or pilot studies. Meanwhile, it is an established and powerful method that can be utilized to develop better understanding and systematically analyse the findings. With ground-breaking insights, the case study has been broadly deployed in testing and producing theory in

the strategic management field (e.g. Burgelman, 1983; Chandler, 1962; Pettigrew, 1973). Case studies can be applied in the early stages of research into a particular topic. For the reasons above, case study is the ideal research method for this study, and I have selected exploratory case study for this research. This allows me to collect rich information which to examine how innovative SMEs are and whether innovation makes a difference for them.

4.3 Research design

Good research is built upon solid interpretations of phenomena. To interpret phenomena in the best possible manner, I have to adopt a rigorous qualitative research design. The research design connects a methodology and an appropriate set of research methods in order to address the research questions. My research orientation intends to describe, examine and explore SME innovation management in a real-world context in order to discover findings as precisely as possible. A clear explanation of my three-phase research setting is illustrated in Figure 8.

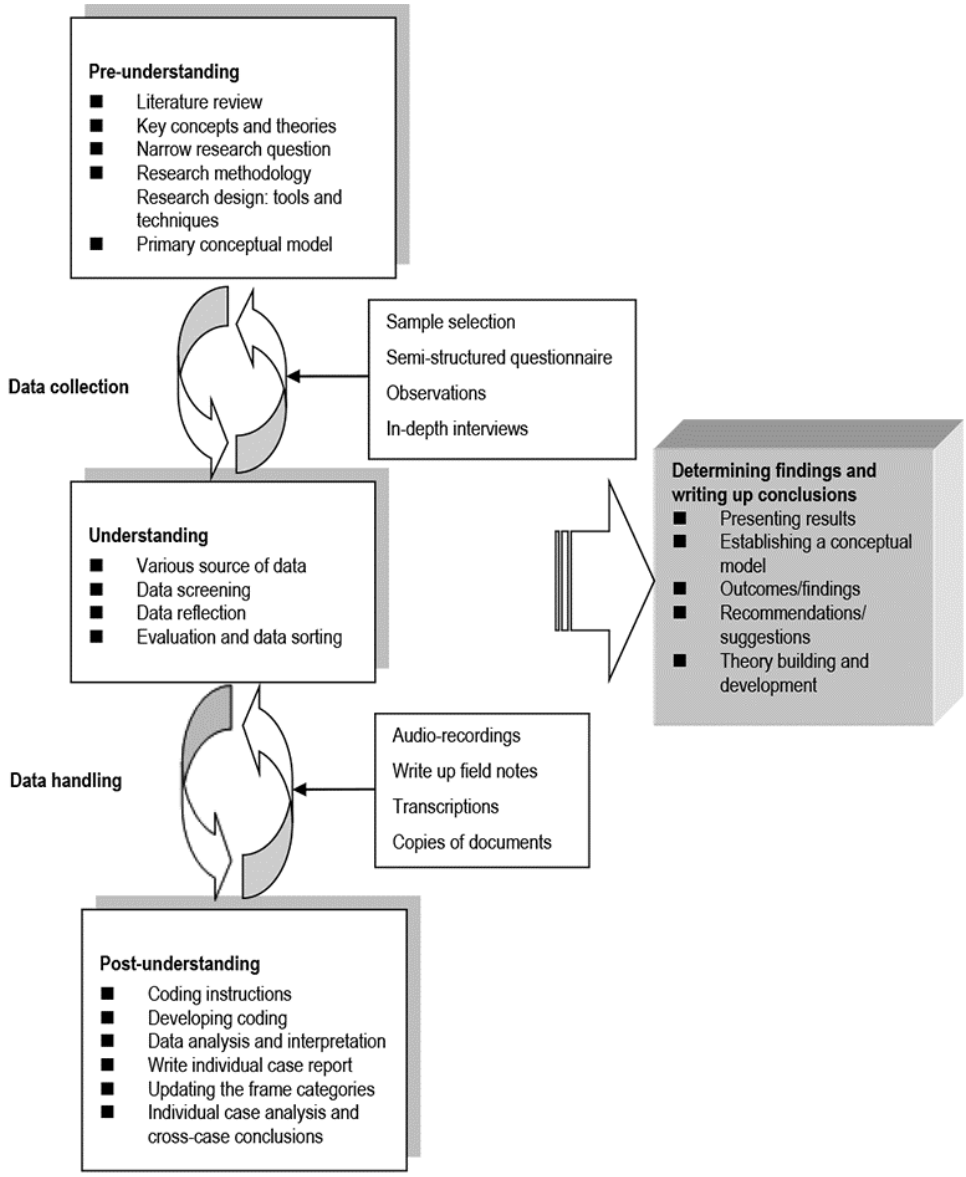

Figure 8. Research process design in this study

This research design can be viewed as an iterative and progressive procedure which is driven by the research questions. It is logical and systematic, offering a clear guideline for the entire research process. It provides a road map for the whole research project. The design of the research process is akin to a recurring process; it is divided into three

phases which are comprised of pre-understanding, understanding and post-understanding. Pre-understanding is the preparatory phase, the major purpose of which is to define a phenomenon that requires exploration; in the present study, this phase runs from my first overview of the phenomenon and to the formulation of my research targets. Understanding is the following phase; in this phase, the phenomena are characterised and then classified into categories, with emphasis on the most meaningful elements in the complex array of phenomena. Post-understanding is the third phase that pertains to the analysis of multiple sources of evidence to the final case study report. The three phases are all study processes involved in progressive cycles between data and literature, moving from existing theory to empirical data and returning to theory. After several recurrences, the final conclusions can be drawn and written up as the findings. The articulation outcomes are based on understanding the phenomena and theoretical synthesis, coming up with a conceptual model to improve existing knowledge.

4.4 Case study research structure

This research is an exploratory multiple case study which is driven by a well-defined project focus. In order to address the research topic, I have identified the fields and questions on which to focus. The design of case study is assumed in a suitable way for this research. The investigation is related to the SMEs in a certain region of China. I conducted interviews in Chinese SMEs at the firm level, focusing on their innovation patterns and innovation strategies. The academic theme sheds light on describing and interpreting the phenomenon of innovative Chinese SMEs in a real-world context. The following steps are synthesised as a clear qualitative case study research framework in Figure 9.

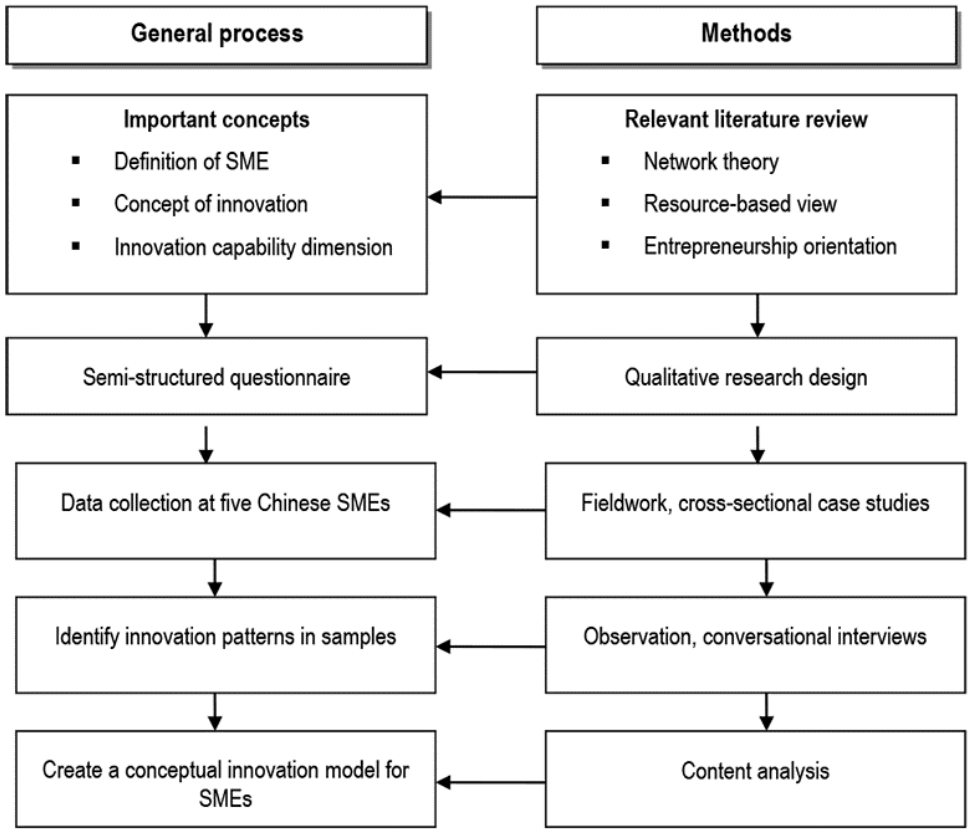

Figure 9. The framework of case study research in this study

Using three basic theories to elaborate concrete fundamental knowledge RBV theory, network theory and EO theory, these theories are three pillars that support the structure of the whole thesis.

After identifying key problems, the qualitative research method was chosen for answering the research questions. The research design, questionnaire, sampling and interview receive full consideration in the case study method.

Designing a semi-questionnaire, the open-ended questions are focused on the business and innovation strategies of firms, especially the ways in which a given firm turns its innovation strategies into action.

Gaining access to samples and determining an adequate sample size, identifying likely possibilities to obtain samples and selecting the correct

participants, data-gathering from a variety of resources, including those providing primary data and those offering secondary data.

Classifying and categorising innovation patterns based on data analysis, establishing a conceptual model in order for SMEs to generate and improve innovation strategically on a continual basis.

4.4.1 Validity and Reliability

Research is about creating new scientific knowledge or adding to existing knowledge. Academic research must yield valid and reliable results. Validity and reliability are essential criteria by which to measure the quality of qualitative research. Validity consists of internal validity, structure validity, criterion validity and external validity (Yin, 2003). Reliability is concerned with the stability, accuracy and precision of measurement. Prior to data collection, I undertook an extensive literature review in the relevant research fields to develop more insightful questions about the topic. I also undertook doctoral-level course training in the qualitative research methodology. Even during data collection in China, I attended a specific training course at Fudan University concerned with how to conduct interviews and write case study reports. These ample preparations and professional training laid a concrete foundation for shaping my academic awareness and thinking, as well as strengthening my research competence. Additionally, I devoted substantial amounts of time early in the process to working on the preliminary issues, such as a theoretical review and formation of the research questions. The research proposal was approved by two supervisors before I embarked on the fieldwork in China. I had an office in the Nordic Centre at Fudan University for seven months. The time dedicated to fieldwork was sufficient for implementing the research process and addressing the specific research perspectives.

As mentioned, this research is an exploratory case study in investigating Chinese SMEs. In order to ensure the trustworthiness of this research, several measures were taken to increase both reliability and validity. First, the research is rigorously designed, from the research framework to the design of data collection. Second, the most appropriate method—case study—was selected to minimise the risk of distortions and ensure reliability. Third, the careful choice of available cases augments

the validity of the study. The sample size is appropriate to answer the research questions. Fourth, based on the trust-laden social networks with the sample firms, I could easily gain access to each case to obtain much more detailed information. The data is considered sufficient and was obtained from reliable resources. Fifth, multiple sources of evidence are used in order to ensure the construct validity of this study. Sixth, to enable the collection of information as accurately as possible, the research process was carried out by using a variety of data gathering tools, including observations, in-depth face-to-face interviews, original documents, etc. Seventh, supplementary sources of information were gathered to enhance data triangulation validity. Finally, a sophisticated data analysis method was utilised. The results thus indicate patterns and trends that could well have wider validity. In summary, the research principles outlined above followed a certain case study protocol to increase the overall quality of the study.

The validity and reliability of qualitative research also depends on the ability and efforts of the researcher. Case study requires a researcher to have suitable academic skills, cognitive abilities and an appropriate background. Conducting a successful case study depends on the researcher's qualities (Collis & Hussey, 2009). Some of my salient traits include having almost ten years of business and management experience in different enterprises and a strong educational background both in China and western countries. I am a qualified researcher with the appropriate skills, rich work experience and academic knowledge. As a native Chinese speaker, there are no language and cultural barriers for me in undertaking research and interviewing people in China. I am also capable of working with the data coding process.

The researcher's own reactions are an essential element of participation (Payne & Payne, 2004). As a researcher, I strove to place myself in a neutral position during the entire research process, trying always for objectivity to analyse and interpret the samples. This study was conducted on the basis of my appropriately and accurately understanding real phenomena.

4.4.2 Semi-structured questionnaire

Formulating good questions is the most important part of a case study protocol (Yin, 2003). I spent a substantial period of time developing draft questions into the final interview questions. A semi-structured questionnaire was designed to gather research data that contains both closed-ended and open-ended questions. The closed-ended questions were aimed at reminding me of key points as references in cases where the conversations drifted or one of the interlocutors forgot an important element. The questionnaire was modified several times based on the research objectives and literature review. The questionnaire was initially designed and written in an English version, and then translated into Chinese via reverse translation. The translation of the questionnaire was undertaken to ensure the appropriateness and original meanings of all contexts, ensuring translation consistency and conceptual equivalence. Most important was choosing a language that could be used to express similar meanings and remain suitable for Chinese informants. To double-check final corrections of the questionnaire, I undertook pre-testing and consultation with a Chinese professor at Fudan University, China. In doing so, some expressions and words were revised to improve the clarity of the questions. All the questions were properly adapted to ensure they were easily understandable by Chinese interviewees. The general questions cover several probing areas, including management, marketing, production and organisational development, as well as more specific questions on innovation activities and business strategies. The questionnaire is comprised of seven sections: 1) information about the interviewee; 2) the company's overall situation; 3) innovation overview; 4) the R&D investment and innovation capability of the enterprise; 5) networks and external cooperation involved in the innovation process; 6) the external environment for business innovation; 7) the company's future development strategy.

4.4.3 Sample Selection

Multiple cases are useful in exploratory studies because they can yield more compelling and robust evidence than a single case study. This study focuses on examining innovation success at the firm level. In order to

gain a more comprehensive understanding of this phenomenon, this research can be described as a mixed multi-case study.

Qualitative samples tend to be purposive rather than random (Kuzel, 1992; Morse, 1994). Silverman (2005; 2013) argues that qualitative research has been practically applied more than any other single method of sampling. Depending upon the type of research problem, a clear set of guidelines about which kinds of cases to include is required. Firm size is an important dimension of the study. The choice of the firms for the sample must fit into the official Chinese SME definition. Meanwhile, the cases selected should depend on the identification of key determinants of innovativeness. The cross-industrial samples were selected in accordance with the following criteria:

- Companies from a particular geographic region;
- Corresponding to the Chinese definition of an SME;
- High-growth SMEs undergoing substantial changes, with indicators of performance, profit and productivity;
- Innovation input: R&D expenditure, the number of patents and patent applications, technological licenses, employment in R&D and number of R&D projects or alliances;
- Different types of innovation activities have been carried out by the company in recent years, including product or service innovations, organisational innovations, process innovations and marketing innovations.

Principally, the sample decision is guided by the relevance of the research questions. This research topic is concerned with a certain innovation management issue in SMEs, and thus it is necessary to obtain information directly from innovative small and medium-sized firms. In order to answer my research question, I had to access specific cases so as to capture data. The sampling criteria shown above are connected with the basic indicators of an innovating firm (Kleinknecht et al., 2002; OECD, 1997). So far, however, there is no unified definition of innovation (Baregheh et al., 2009) and no standardised measurement of innovation in the research (Becheikh, Landry, & Amara, 2006). Therefore, the innovation measures employed here can be considered accurately and objectively appropriate.

It is a challenging task to collect data on SMEs in China; it is also difficult to undertake a strictly random sample investigation. The case

study in China was conducted in cooperation with Professor Ning Zhong, a senior professor in the School of Management at Fudan University and Associate Professor Hilary Hu from Shanghai University. I received enormous assistance from both in the process of sample searching and sample selection. Case firms were selected based upon the most reliable sources and particular criteria. Professor Ning recommended two firms, from which I chose one that met the criteria. Meanwhile, through Associate Professor Hu's introduction, I had the opportunity to speak with a Mr Peng, who works at the administrative office of Science and Technology in Jiading district in Shanghai. His job is to promote innovation among SMEs. He helped me contact three Chinese firms in the Shanghai region. One company was discarded from the sample pool because its size failed to meet the Chinese SME definition. This company was incorporated with its parent company and became a group company in 2009, employing over 1,000 people in total. In addition, I also utilised personal social networks to seek other case firms. I found three firms, but only two accepted my interview requests. One company declined to be interviewed because the owner was not willing to take part in the research.

Because my study is focused on innovation, I decided to investigate SMEs in a relatively narrow fashion. First, the cases were chosen on the basis of a purposive sample rather than on a random basis. The selected firms fit within the definition of Chinese SMEs in terms of number of employees and business revenues, as well as fulfilling the criteria above. Second, sampling decisions were based on criteria that had relevance for the research questions. Third, samples of limited size are based on an appropriate selection. In short, the investigation of cases focuses on a small sample of companies across different industries in China. There is no "correct" sample size required in qualitative research. Eisenhardt (1989) and Yin (1994) suggest that the case study research for replication purposes should have at least five cases, so the sample size in this study suffice for producing data rich enough to answer the research question. Table 3 offers a brief summary of the key features of the five cases.

Table 3. Summary of case firms

	Company name	Industry	Year of establishment	Location	Approx. number of employees	Main products
1	Win-all High-tech Seed Co. Ltd	Agriculture	2002	Anhui, Hefei province	136	Hybrid rice seed
2	Shanghai Huize Medical Instrument Co. Ltd	Medical	2006	Shanghai	210	Intravenous catheter
3	Shanghai Xiwo Electrical Apparatus Co. Ltd	Automobile	1996	Shanghai	230	Automotive electronic components and accessories
4	Hubei Changjiang Electric Co. Ltd	Electric	2005	Wuhan, Hubei province	600	High and low voltage complete power distribution equipment
5	Shanghai Leo Laser Equipment Co. Ltd	Machinery, Automobile	1988	Shanghai	61	CO_2 laser equipment and laser manufacturing process

Five firms were selected for the case study with a wide industry spread, so as to obtain a broad understanding of the phenomenon under study from a variety of perspectives. The sample covered a cross-section of diverse firms, including the bio-agriculture, automobile, electrical and pharmaceutical industries. The case firms are production-oriented SMEs, but produce different products and have different technologies focused on different markets. All the case firms are privately-owned enterprises with employee counts between 60 and 600. There are no micro firms. Two are medium-sized enterprises and three are small-sized enterprises. The companies had been in business for an average of 15 years.

4.4.4 Data collection techniques

Stake (1995) and Yin (1994) identify at least six sources of evidence in case studies, including interviews, direct observation, participant observation, documentation, archival records and physical artefacts; all

can serve as data-gathering techniques for qualitative research in business and management. In this study, I employed several typological data capture tools to carry out the qualitative research.

The interview is the most commonly used data collection technique for gathering empirical data, even in cross-disciplinary research. An in-depth qualitative interview is an essential source of information in case study research. In practice, the interview data should be gathered from the people who are most suitable for answering the research questions. My case study was designed to accumulate data through in-depth face-to-face interviews with owners and founders, top managers and other key people in SMEs. The founders or top managers are the key persons, with the highest positions within the company, and have the power to make decisions about strategies. They have more information and understand the innovative activities of their firms intimately. Furthermore, the interview also allows the benefits of a conversational style. In order to capture adequate first-hand data, conversational interview techniques via face-to-face, semi-structured interviews were applied in this research. I created a more relaxed atmosphere to encourage interviewees to feel free and open to talk about their companies or tell stories in their most complete form. The participants were able to describe their views of reality though narratives, which allowed the researcher (myself) to understand the participant's actions more fully (Lather, 1992; Robottom & Hart, 1993).

Observation is another tool of data collection. Observation is one of the most distinctive features of case studies (Yin, 2012), and can be regarded as a formal protocol by which to measure and record behaviours or casual data collection activities (Tellis, 1997). I spent many hours observing the actual activities that took place at the sample firms. Direct observations were made at each firm, involving looking around the different offices, workshops, plants, warehouses, the laboratories of the R&D department, and the company's bulletin board, visiting the manufacturing area etc. I carefully observed everything relevant to innovation processes at all the organisations. Moreover, the close onsite observations of the production workshops were accompanied by the production managers, who described production lines and demonstrated their products. To increase my understanding of technological issues,

they introduced their production processing and answered all the questions that emerged during the observations.

Documents are a type of supplementary data source, so I also used a series of public and private documents to triangulate the information gained from the interviews (Eisenhardt, 1989); these included industrial reports, organisational charts and internal company reports. Some interviewees showed old photographs to me in order to sharpen their memories of specific events and tell their stories in as detailed a fashion as possible. They even showed me highly confidential documents for brief, onsite review.

4.5 Data collection process

The data for the study was collected from both primary and secondary sources over a period of seven months. The fieldwork in China was highly intensive. The research took place from September 2011 through the end of March 2012 in three different cities (Shanghai, Hefei and Wuhan). The investigation was carried out in five Chinese firms in diverse industries. The case studies were conducted on a purposive sample basis. I did not deliberately seek a representative sample of firms or industries. In-depth interviews were carried out at five different firms which involve a wide variety of sectors. For the purpose of generating a deeper interpretation, I intended to collect as much relevant evidence from the case firms as possible. The raw data in each case originated from multiple informants and sources.

The sampled companies were first contacted by telephone to confirm whether they approved my being part of the research. Before going to the sample firm, I had a basic pre-understanding of the company's profile and any related information that could be found on the Internet. Normally, because the sample firms were quite small, there was very little information available online. I visited the sample firms several times. Data collection was conducted during between three and fourteen individual interviews for each case, with informants including founder-owners, CEOs, presidents, vice presidents, production managers, marketing managers, R&D managers, quality control managers, HR managers, etc. These key people were all assumed to have substantial

knowledge about their business and a good overview of their company from their different perspectives. Generally, I made appointments individually with each informant to ensure ample time for each interview. The personal interview time was arranged at each informant's convenience. The interviews were generally formal, but there were also occasional informal discussions. The formal interviews took place either in informant's offices or the company's meeting rooms. The informal interviews took place in the company's cafeteria, restaurant or even at the informant's home. For instance, I went to the home of the Win-all company's formal vice president and founder to conduct an interview. My first meeting with the Huize company's assistant manager took place at a restaurant outside the company. The details of interviews and visiting times are accounted in Table 4.

Table 4. Details of interviews and visiting times

The name of case firm	Number of visits	Total days	Number of informants
Win-all Hi-tech Seed Co. Ltd	3	5	13
Shanghai Xiwo Electrical Apparatus Co. Ltd	1	1	3
Hubei Changjiang Electric Co. Ltd	2	4	7
Shanghai Huize Medical Instruments Co. Ltd	3	2	3
Shanghai Leo Laser Equipment Co. Ltd	2	2	4

Prior to the commencement of each interview, I started by asking the participant's background and workplace position and briefly introduced myself so we could get to know each other. I then presented the questionnaire to the interviewee to introduce them to the research topic and the purpose of the interview, as well as the promise of confidentiality. As it turned out, after only a brief glance, most interviewees returned the questionnaire to me and allowed me to ask questions freely. During the interview process, the questions asked were not restricted to the pre-formulated questionnaire. In order to gain an overall picture of case firms and to increase my understanding, many additional questions were asked to capture as much data as possible.

Moreover, when interviewees used industrial or technical jargon, I normally asked them to give me a short definition.

The length of the interviews was generally from one to three hours. The entirety of each interview was audio-recorded, and handwritten notes were taken in Chinese at the same time. I tried to make as many notes as possible on the spot. The investigation followed the main lines of the semi-structured questionnaire. Moreover, in order to better comprehend the products, markets and business operations, many unstructured questions were asked on the basis of information provided by the interviewees. The interviewees were able to identify how and where innovation was occurring in the company. There was a certain trust developed between the interviewees and myself, with many willing to tell complete stories and offer reliable information. Moreover, three follow-up interviews were conducted so that informants could clarify as necessary or fill in incomplete answers caused by shortness of time in the earlier interviews. Token gifts in the form of a university souvenir were given to informants at the end of the interviews in thanks for their time and cooperation.

As to the contents of each conversation, I worked on the audio recording transcripts soon after each interview. The preliminary data analysis involved reviewing the written-up field notes and checking the audio records for clarity, summarising key thoughts and writing them down. In total, the data was obtained by conducting 2,294 minutes of interviews with 31 key individuals. There are 50 pages of handwritten field notes. Concerning the scope and topic of the study, these numbers can be considered appropriate. The interviews contain much technical terminology and information. During seven months of exploratory fieldwork, I learnt a lot from the data collection, with each case giving me specialised knowledge and a unique experience. The key informants are listed in Table 5 (more detailed information can be found in Appendix C).

Table 5. The participants from the case firms

Key informants	Huize	Xiwo	Changjiang	Leo	Win-all
Founder/CEO		*		*	*
Former founder/CEO					*
Vice manager					*
Production manager		*	*	*	*
Marketing/sales manager			*		*
R&D / Technology manager	*	*	*	*	*
HR manager	*		*		*
Quality control manager		*	*		*
Administration director	*		*	*	*
Warehouse manager/purchasing management			*		*
Subsidiary manager					*
Sales team leader			*		*

The purpose of the study is to understand the real experience of SMEs through a broad cohesion to the contemporary innovation management literature and theories. The primary data was acquired in firm-level investigations concerning the sample innovation strategies, activities and innovation capabilities. I collected a great deal of interview data from each company. The numerous first-hand data from the each case was concerned with their technology, organisation, production and marketing. This was sufficient to allow me to investigate the innovative patterns of sample firms in a variety of areas—their characteristics, activities and strategic emphases.

In addition to the primary data, secondary data was also gathered. Secondary data is other important data that has already been published or exists in an archive that was collected for another purpose. The secondary data came from two basic sources: internal databases and external databases. The internal databases already existed within the companies. I selected pertinent information obtained from each company's brochures, archives, publications, internal documents, newsletters, annual reports, company's webpage, and so forth. Examples include informative documents such as a company's current strategic

activities or future plans. External data were collected by sources outside the company, such as published material, advertisements, newspapers, online databases and surfing the Internet. Additional information was also gathered from websites such as a company's history, organisational structure, production line and service information. The industrial reports provided information about technological and market conditions. The comprehensive set of secondary indicators reflects both firm performance and industry circumstance. It is important supplementary data for validating information. I employed secondary data to crosscheck data triangulation and corroborate the primary data in each case.

4.6 Data analysis and interpretation

Since empirical data was obtained from direct observations, interviews and documents, consequently, the analysis is based on the examination of numerous factors and nuances. The aim of my data analysis is not only to describe the information that I obtained, but also to explain data implications so as to offer a coherent connection with the relevant theories. This involves not simply focusing on each single case, but also exploring common underlying results from cross-case analysis. Taken together, the innovation practice of these firms is comprehensive. The challenge of data analysis is to incorporate theoretical concepts with empirical investigations, thus adding new insights to existing theories. Based on micro-level evidence, my data analysis follows the line at the organisational strategy level instead of other levels (regional levels or national levels). To cope with the large scale of qualitative data, I deployed a qualitative content analysis approach to examining the data in order to ensure an objective and deeper interpretation of the text interviews (Neuendorf, 2002; Krippendorff, 2003). I mapped out the content analysis procedure in this research as outlined in Figure 10.

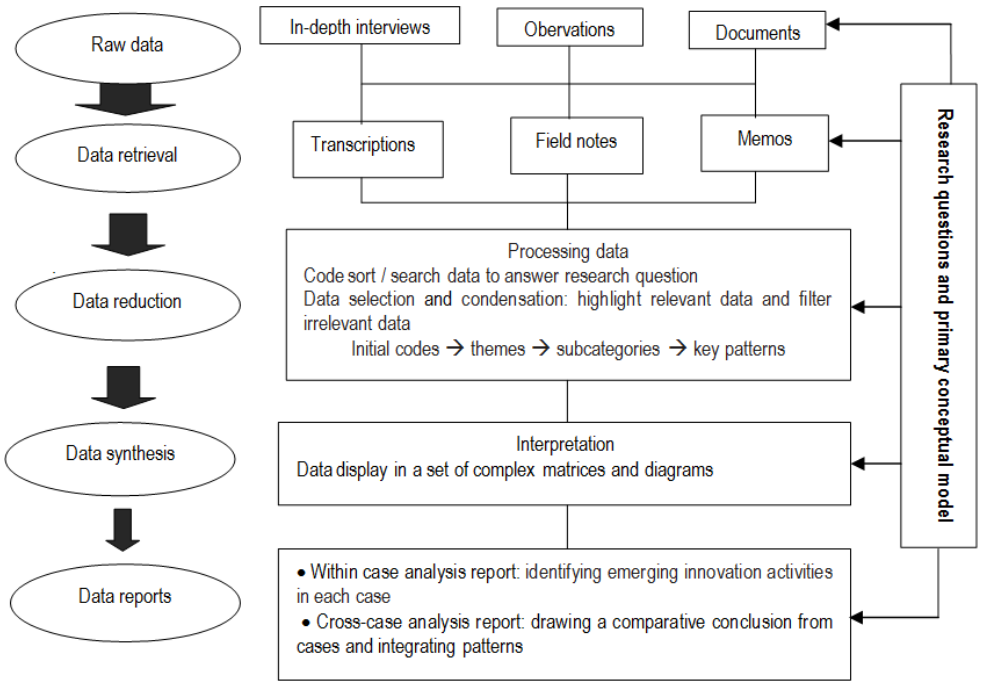

Figure 10. The construction of data analysis procedure

Careful data analysis was performed on the basis of manual content analysis. I emphasised data critical to answering the main research questions. These cases are elucidated on the basis of a description and are experience-based. From my point of view, to ensure accurate understanding of regional Chinese dialects, it was better to employ a manual coding approach to interpreting actual meanings. Human coding is not limited only to text that is beyond the ability of computer coding to analyse latent content (Krippendorff, 2003), because a word takes on different meanings in different contexts, which computers cannot discern. Using computers to deal with this coding was likely to be more problematic, although computers are useful when categories are numerous. In fact, the data analysis process was quite time-consuming as a result of employing human coding.

On account of the large volume of raw data, I selected the parts of the recorded interviews, then transcribe verbatim and translate them. My data analysis was focused on putting the pieces of information fragments together from the interviews which are related to the theoretical concept

of innovation and types of innovation. The emphasis was on the information that best addressed the research problem. I carefully screened information from the audio recordings to determine whether particular data was suitable for answering my research questions. Miles and Huberman (1994) introduced a series of procedures for analysing qualitative data. Following these, my analysis procedure moved from the data sources, coding, developing, refining analytic themes, relating to extant theory, and selecting further data for the next phase of analysis. In fact, there was a gap between the theoretical definition of innovation and the interviewees' own particular answers. I went back and read more relevant innovation literature to enable me to make better sense of the data. I want through qualitative data (interview, observation notes and documents, etc.), identifying particular data around the themes of this study. I attempted to address a broader array of innovation issues through examination of different data sources. I carried out an inductive analysis on the basis of the theoretical framework which was presented in the last chapter. By ignoring irrelevant and redundant data, I essentially concentrated on discovering significant details or meaningful evidence to help generalise findings. The data retrieval procedure consisted of the identification of key words and phrases, which were then grouped into the main theme. Applying the content analysis technique, I established the subcategories of innovation patterns to specify different aspects of the innovation in those case companies, such as cost-efficiency innovation, product-specialised innovation, customer-oriented innovation, market-driven innovation, etc. The example of data interpreting and analysis is demonstrated in Appendix D. I deployed a consistent analysis method in order to enhance the robustness of results, taking into consideration not just whether companies had achieved major innovations, but also the degree of their innovativeness and the elements involved in their innovation process. The level of analysis was set at the firm level. Following the logical implication of the original data, fine-grained analysis proceeded from the bottom up, and developed theories were used to proceed from the top down. The data was displayed in a set of complex columns with categories. I presented the case evidence neutrally, briefly quoting critical interview contents to draw specific conclusions.

To be able to draw on a diversity of data sources, the description of data analysis was comprised of both individual within-case analysis and cross-case analysis. The within-case analysis was used to describe and explicate the innovation process in a single focal firm, covering four aspects. First, the industrial background of each case is introduced. Because case enterprises were within diverse industrial sectors, their specific industrial characteristics should be taken into account. Second, the innovation typology of the individual case was identified and the successful experiences of each innovative firm were elaborated. Third, innovation activities in different company development stages were analysed. Finally, the patterns of innovation strategy were summarised into categories using tables and diagrams. The cross-case analysis makes connections between the five cases, particularly shedding light on their similarities and dissimilarities, and then finding common issues from the synthesis. The innovation process and the involvement of external actors were outlined.

In summary, the data acquisition and analyses from those cases offered me a valuable opportunity to gain insight into how Chinese SMEs can strategically create new knowledge and generate sustainable capability from innovation. The various SME innovation patterns were analysed from multiple perspectives in terms of innovation resources, performance and innovation capabilities. I also constructed an integrative model for SME innovation. This research as a whole can be considered a combination of scientific, theoretical and practical viewpoints, which are much broader than simply choosing the data collection and analysis method. This study makes a contribution to knowledge in the area of SME innovation management.

5 MULTIPLE CASE STUDIES

5.1 Case study 1: Huize company

Background

Huize Shanghai Medical Instruments Co. Ltd was established in March 2006. Huize is a privately owned small medical manufacturing enterprise which undertakes medical device production. Their products are intravenous catheter and infusion sets. The company aims to develop and promote internationally advanced medical instrument production and technology for China's medical device market. The company's founder is Mr Wang, who lived in Japan for more than 26 years. He bought a Japanese patent and returned to Shanghai in 2005. The patent was for the "Indwelling Intravenous Catheter" (an anti-reflux venous indwelling needle). In 2006, he invested his own savings of around 40 million RMB to build a factory in the Songjiang Industrial Park near Shanghai. The factory has 180 employees, which is engaged in intravenous catheter R&D and production. The factory covers an area of 8000 square meters and the plant construction area is 2700 square meters. The production capacity was originally designed as 12 modern assembly lines, all of which were imported from Japan. The headquarters of Huize lies in the city centre of Shanghai. As a commercial and marketing office, it has five departments with 30 employees.

The company has obtained ISO9001 and ISO13485 quality management certificates. The ISO13485 is a management systems standard specifically for the manufacturing of medical devices. Huize has passed GMP (Good Manufacturing Practice for Pharmaceutical Manufacturers) quality inspection, obtaining its GMP certificate in August 2011. After several years of development, Huize has developed a good reputation and market awareness.

This company was established to introduce the latest medical device technology to the Chinese market. Before founding Huize Company, the

CEO, Mr Wang, had no previous experience working with IV catheters and no personal relationships with the pharmaceutical industry. Although he knew it was a sustainable technology in a promising industry, he also realised that it would be very risky to venture into unfamiliar business territory without any assistance from others. During the early stages of his new business venture, he contacted experts to gain the relevant clinical knowledge and market information, building his personal networks within the medical instrument industry. The pharmaceutical industry is a specialised industry with comparatively high barriers to entry. Generally, companies involved in this industry must have a drug license which is issued by the State Food and Drug Administration (SFDA) in China; the legal approval process takes between two and three years. The clinical trials of Huize's products began in 2006, and were run in different hospitals simultaneously. They worked with hospitals in Beijing to get their IV needle to pass through a variety of rigorous clinical trials. Huize received first product permission that permitted sale on the market in March 2008.

As a new entrant firm, the 'Greenfield' business operation was not successful. Huize ran into a series of problems. When their new products were launched on the market, sales were not very good. From March to September 2008, the products faced a number of reports of "quality defects". In fact, IV catheter is a sort of innovative product that the needle differs from conventional needles and required some changes in injection routines. Frontline nurses have been practicing a certain method of injection for many years, and they needed lengthy, special training to become accustomed to the new product. When applying the old method with Huize's products, many problems developed, such as liquid leakage and vein-puncture difficulties. To ensure the quality of its products and protect the company's fledgling reputation, Huize had to recall several batches of problematic needles from retailers. This led many nurses to think that their products had quality problems or other flaws. Almost two years after its inception, their product had very low market recognition and little acceptance among users.

At the start-up stage, the resource input and finance requirements were great. Huize encountered many obstacles, including the company's unknown reputation and brand, expensive training for nurses, limited marketing channels, and a shortage of finance. Because Huize lacked

venture capital to fund its business, the founder and CEO, Mr Wang, had to pump more of his own money into the company in order to continue the firm's cash flow. He sold his seven apartments in Shanghai to pay the salaries of his employees and negotiated deferred payments with his suppliers. The early stage of this company was its toughest period. The situation has changed since the beginning of 2011. Huize broke even later that year, and the company soon started to make a profit. Since then, the market channels have opened, their product has been gradually recognised and accepted by users, and the quality of the products became more consistent. It now has about 200 sales outlets and distribution channels covering all of China, except Ningxia and Tibet provinces. However, Huize is still in the initial phase of development. The next phase of growth involves scaling up in size and profitability.

Industrial environment

The high-tech medical instrument and equipment sector is one of the most promising sectors in China. China's medical device market has seen rapid growth in recent years. According to a report from China's Medical Ministry Statistics, the growth rate of the Chinese medical device market increased to 23% in 2010, with the market reaching 120 billion RMB annually. China's potential demand for IV catheters increased from 15%–20% per year. From 2004 to 2012, the domestic medical instrument market CAGR (Compound Annual Growth Rate) averaged 27%. Compared to the pharmaceutical market, China's medical devices market is at the infancy stage of development. The total volume of China's medical device market was around 100 billion RMB in 2012, and predicted grow to approximately 340 billion RMB by 2015.[7] China's medical instrument industry has large room for growth; the two main reasons for this are the Chinese government's increased investment in healthcare and the rapidly growing health needs of Chinese residents. Under health care system reform, China's central government plans to invest nearly a trillion RMB to expand health insurance coverage from urban to rural areas. In the coming years, the demand for medical devices will be enormous, and China's medical device industry should have a bright future.

[7] http://wenku.baidu.com/view/d419f7eb102de2bd96058831.html?re=view

Product-specialised innovation

Huize Company has been granted the intellectual property rights for the new utility in 2007 and the invention in 2009. The patent application process only took half a year. This proprietary technology was bought from Japan. The founder Mr Wang paid around 200 million Japanese yen to purchase a medical instrument technology patent called the "anti-counter-flow intravenous catheter". This decision was driven by his idea of filling a medical technology gap in China. He also seems to possess strong market perception. He foresaw the enormous commercial potential and high margins of the medical instrument business in China.

The anti-counter-flow intravenous catheter is a very fine specialised needle that prevents reflux of blood. It contains a hydrophobic membrane filter which is like a control valve device that can close off blood backflow. The indwelling needle has a double-tube structure composed of a catheter tube and an inner needle. It can generally be retained in a vein's blood vessel for 72 to 96 hours. The anti-counter-flow intravenous catheter is the third generation of intravenous therapy and there are no substitute products. It can effectively prevent blockage, reducing the incidence of phlebitis and the work required by nurses.

"Offering safe and reliable products" is the company's essential goal. Huize produces a set of intravenous needles, two major series styles (Y-type and Pen-type). The size is based on different amounts of per-minute infusion (14G, 16G, 18G, 20G, 22G, 24G, and 26G). Huize uses high-quality raw materials in their products. The main components of its products are imported from Japan, the United States, and Finland. The metal needles and the fixed steel core are imported from Japan's Kotobuki Industries. The stainless steel syringe needle has a sharp blade edge on its tip that more easily punctures the skin and offers a better flow. President Wang has a good relationship with his Japanese suppliers and visits them regularly. Huize stays in close contact with overseas suppliers to buy high-quality advanced raw materials and components. A Finnish medical company supplies the "FEP remaining cannulas", which have a unique flexible feature and biocompatibility, staying safe and comfortable in the blood vessels. The rivet of the needle is imported from the United States.

Huize's strategic vision is: "Providing science and technology service for the market; Honesty is a key fundamental of the company". The main

development direction of the company is to introduce and transform technology through an integrated growth model of technology research, manufacturing and marketing. Huize has been committed to product-based innovation since its establishment. The product-specialised innovation strategy was formulated by the founder after analysing the condition of the company's core technology capability.

> Although our company is a relatively young company, we are the only company to produce high-tech intravenous retention needles in China. There is a significant commercial potential for IV catheter technology in the medical device market. We are focusing on one sort of product. We pay attention to improving the quality of our product and branding ourselves. We have great confidence in our products. Except for the patent we have, our core technical competences are plastic mould-making and adhesive assembling technology. For example, this 26G I.V catheter is as thin as a hair, which many firms could not produce. (Assistant Manager of Huize)

Huize is devoted to producing highly value-added products. The 26G needle is a very small needle. Huize has developed this kind of very small product for elderly patients and infants. In fact, only a very few medical instrument companies can produce such small needles in China. Huize emphasises developing strong in-house expertise to enhance its competitiveness. The mould-making process requires that different component parts have a certain cohesion, and thus, a high-precision tool must be designed for mass production of the needles. Injection moulding technology ensures accuracy when the catheter head is molten to form the head tubes, being trimmed to a smooth and precise size after cooling is completed. The company's manufacturing capability lies in the plastic moulding technology incorporated in its adhesive assembling technology. Huize can produce with high precision, ensuring that a needle can be as small as 0.33 mm, the smallest size of intravenous catheter. This professional technology allows Huize to differentiate itself from other competitors. Huize not only has a set of complex testing equipment and highly advanced detection methods, but also expends efforts on research and continual development. In 2011, the R&D expenditure on projects and equipment was 1.5 million RMB, accounting for around 18% of sales revenue.

The R&D team concentrates on its core technology research and development. Huize hired a technical expert from overseas for its R&D

and technology director position. He has a mechanical education background, and had worked in a medical instrument company in Malaysia for a number of years. He explained that:

> The IV catheter is a labour-intensive and technology-intensive product. Besides labour input around 30–40%, the majority is technology input which takes 60–70%. We have four R&D staff now, engaged mainly in strengthening our in-house R&D. In order to provide the finest products, the key issue is to refine our advanced technology and to develop peripheral products. We put our limited resources into the most critical areas of the company's growth. We expect to improve our cutting-edge technology and become a leader in this special market segment.

Intellectual property is particularly significant in the medical instrument industry. Huize has an advanced technology compared to its rivals in the medical device sector in China, and it intends to remain in its technologically leading position in this particular product area. Because it has a single-product strategy, the protection of intellectual assets is considered of utmost importance at Huize. This strong awareness of intellectual property protection has allowed Huize to develop smoothly over the years. Their patent serves as a weapon to protect their advanced technology and consequent commercialisation. Meanwhile, product refinement and improvement has been strictly in-house so far, which prevents the company's core knowledge from leaking to outsiders.

> We have been innovative and placed ourselves in the right position in the market. We are not following others or replicating their business models. To be frank, our current technological capability is ahead of our competitors. Being technology- and market-focused has led to our business success. We want to be perfect in the production of IV catheters. We want it to be a specialty. We are only operating in this industry to step deeply into that area. It requires our efforts and our expertise (Assistant Manager).

As a niche player, Huize aims to develop cutting-edge intravenous catheter and accessory products. Their R&D emphasises the conversion of patented technology to their own specialised knowledge in order to reinforce existing products. The R&D team is committed to product improvements, searching for innovative techniques in peripheral catheters. They are currently innovating in needle infusion set to extend the firm's product range. In order to continually reinforce the safety of

the products, technological design of their new products is aimed at reducing the risk of accidental needle stick injuries.

Market-focused innovation

In China, many domestic and international medical manufacturing companies do not only produce one kind of specific medical instrument. Huize defined a market-focus innovative strategy combining its own situation and industrial development trends. Under the guidelines of a focused strategy, the company market positioning emphasises IV catheter products and specialisation into the target segment.

> We are not a pioneer in this sector. We sold common IV catheters at the time of the company's establishment. That was just a way to open the market, to build the brand name. Our main purpose is to sell the anti-counter-flow IV catheter. There is more demand for this kind of functional medical product, and we have professional advantages. Our present sales revenue is like this: 70% of our total revenue is from anti-counter-flow IV catheters; only 30% comes from the common IV catheter. We have taken the market share from some big multinational companies, such as the BD Medical Technology company and the B. Braun Medical Company. Although the Chinese market is growing quickly, we compete with them in a particular product segment. (Assistant Manager)

Competition was intense in China's medical syringe market several years ago, but it was beneficial for the Huize company as it was entering the IV catheter market and this segment was undergoing rapid growth. As with many new firms, Huize simply strove to survive in the first three years. At that time, two of the world's leading biggest pharmaceutical firms, BD and B. Braun were the giants dominating China's medical industry, with greater financial resources and superior market power. Almost three quarters of the domestic Chinese market in IV catheters was held by BD. As one of the medical needle production giants, BD entered Chinese market in 1995, founding Shuzhou BD Medical Instruments Co., Ltd at the Shuzhou industrial park in Jiangshu province. It was hard for Huize to compete against those large rivals in terms of capital and ability. In order to survive and increase its brand recognition, Huize Company's first step was to explore the market by mainly selling the common IV catheter. Its product was priced slightly cheaper than those of its rivals. After obtaining a market share and brand recognition, Huize started to

promote their more competitive product, the anti-counter-flow IV catheter.

> We clearly knew which particular market to capture. We concentrated on the IV instrument market because it was the market we knew everything about; we didn't know anything about any other markets. Our marketing goal is to highlight a more specific niche market segment where we have advantages. You probably don't know that medical devices are specialty products. Running this business, you must join in a kind of professional network. We are a newcomer in the medical community. Attending Chinese Medical Association events is an effective way to build our brand, achieving networking and access to buyers. (Office Director)

Huize concentrated on the large-potential and high-growth domestic medical device market and gradually penetrated a small niche segment. By considering the specifics of medical products, the company's marketing strategy addressed to improve its brand and corporate image by advertising in a well-known and influential medicine journal (Chinese Medical Nursing Magazine). Meanwhile, Huize is an active member of the Chinese Nursing Association (CNA). By giving financial support to the CNA to organise conferences, forums and affairs, Huize has greatly enhanced its reputation and brand in the medical care network. It is an effective promotional method that is bringing Huize a rapid expansion of their market share. Huize also actively participates in various national and international medical instrument exhibitions and trade fairs for product promotion purposes.

> The final consumers are patients, so they are willing to pay higher prices for products with improved functionality and safety. However, hospitals are the actual buyers, so nurses are the key persons who have the right to choose which kinds of products they want to use with patients. They expect product reliability and convenience. On the other hand, nurses need to be educated in the use of innovative needles, so we increased the training input to teach nurses how to use our products. As a small new company, we must take into account the kind of resources we have. Marketing and distribution is the hardest part for start-up firms. Our products are primarily sold to hospitals. We have limited resources to build our own sales channels to the hospital markets. We depend on local retailers for selling to limit market risks. (Office Director)

Because they have insufficient resources to build and expand their own distribution channels to reach more hospitals, Huize uses business-to-business (B2B) marketing to sell its branded products. The primary

function of the marketing department is providing technological support to hospitals, including the training of nurses, after-sales, advertising, branding, etc. To increase education and change the way that nurses practice, they organise product training to teach nurses how to use their products, such as free courses in injection skills and IV product knowledge. The sales department is responsible for market expansion by seeking distribution channels and maintaining relationships with medical retailers and dealers. They utilise distributor networks for marketing and services. Huize established a commission structure for expanding retail outlets. They are building geographical proximity into distribution networks to ensure their products can reach the marketplace. Those retailers operate as their sales representatives and cover China's different geographic areas. Local distributors can be more sales efficient than Huize in developing their own sales forces.

> Because the local dealers have strong distribution networks that can reach many hospitals, we utilise their sales forces and networks to facilitate our marketing capability. We are involved in medical associations and communities to obtain more market information. The feedback from our local retailers can also help us to understand the market's demands better. Being focused, we are exploiting the market gradually and steady. (Office Director)

Huize offers a higher sales margin for dealers than do their competitors, which means the dealer makes more profit when selling Huize's products. This tactic has fuelled growth in the distribution chain, which greatly impels the company's sales growth. Due to the high-quality and advanced technology of their products, Huize has gained market recognition and reputation in a short period of time. Because Huize is growing rapidly, dozens of medical distributors now want to cooperate with them. They select reliable distributors carefully and then build long-term co-operative relationships with them. They usually first examine the potential partner company, determining whether it has legal medical distribution permission, basic economic strength, a good business reputation, strong market development capabilities and sales network, and extensive experience in market operations. The distribution network is formed on the basis of regions occupied by different local dealers so as to avoid overlap. Taking into account regional differences, Huize offers a

flexible pricing policy to ensure that dealers are able to make the appropriate profit.

Huize also builds strong relationships with local distributors in order to remain aware of the market situation. Useful market information from its dealers has allowed Huize to create a niche in the marketplace by offering products with considerable market demand. So far, Huize sales have shown a steady growth; their products are sold through 200 regional exclusive distributors all around China. Market sales were two million units in 2010 and four million units in 2011. Revenues reached 4.8 million RMB in 2011. As a relatively small firm, Huize continuously pursues stable development with a focused strategy.

Summary and implications

Huize was not a pioneer in the IV catheter market in China, but it succeeded in introducing a new product and continuing to develop cutting-edge technology. Why is Huize growing rapidly? Huize developed expertise in a particular technological field to become a leader in that niche market. Huize has adopted two innovation patterns; a product-specialised innovation strategy and a market-focused innovation strategy.

Small firms can find that their size creates difficulties that larger firms do not face, particularly as regards sufficient resources. SMEs have to engage in selective focus in order to be innovative. SMEs should make great efforts to build innovation capability according to the resources that they have. Technological innovation is simply crucial for medical enterprises. Considering its own current technological situation and industrial development trends, Huize formulated a product-focused strategy by focusing on its own core technology development. By promoting the application of advanced technology to replace traditional products, Huize made efforts to develop in-house expertise and special skills. By ensuring a high degree of specialisation, Huize has established competitive niche advantages in the medical device sector. It is a challenge for a small start-up firm to maintain its technical advantage in all potential areas. Huize's strategic positioning is aimed at being at the leading edge by strengthening technological expertise in a highly specialised field. Huize focuses on one product, and continues to renew the product by increasing the degree of product innovativeness. The R&D

of product improvement is based on its latest patented technology. They developed a sharp strategic approach in the field of high-tech IV catheters to upgrade the technical specifications. With this product-based innovation strategy, Huize is keeping ahead of their competitors in the marketplace. The emphasis on a particular product yields sustained profit and growth. As do other small enterprises, in order to prevent their technologies from being imitated by competitors, Huize diligently protects its intellectual property through the legal system and maintains independent research and development efforts within the firm. The patents in Huize are vital to maintaining their competitive advantage. The firm's differential technologies are based on buy-in patented knowledge plus self-developed R&D.

As far as small young firms are concerned, capturing profits to survive is regarded as the most important incentive for innovation. Marketing capability is a core competence in small business survival. Huize defined its target market and placed itself in a niche position in the Chinese market. Huize pays attention to its main business area and works to improve its core competence. To mitigate its relatively small size and resource constraints, Huize's market-focused strategy is aimed at specific market segments. Huize enhances new product commercialisation and sales-force efficiency through networking with distributors, thus it can not only concentrate on its strengths in retaining a high level of technology, but also reduce its operating costs in market expansion. Their connections with dealers enable faster market penetration and enlarge their market share, and Huize can also use those external sources to gain market information to aid new product development. Huize remains in a particular medical instrument market. It highlights IV catheter field in order to exploit its proficiency in this area. By occupying a small market segment, Huize is able to underpin its specialised market position.

Huize has moved from being a late-comer to being a fast mover. Its innovative strategy is to expend efforts in its main business, deploying its limited resources on a specific technology and market segment accordingly. Huize's rapid growth is derived from its distinctive technological advantages, on which the company continues to focus. Aiming to be ever more excellent and professional, Huize stresses its

firm-specific knowledge in order to reinforce competitiveness in its target market and to realise improved business performance.

Table 6. Huize company analysis

Type of technology in the case company	**Sub-category**	**Theme**	**Key points in empirical data**
Advanced technology	Market-focused innovation	Emphasis on a particular niche market segment	- Keeping professional technology at leading level with the intent of dominating a specific small segment - Improving its brand and reputation in the medical care network - Carrying out market expansion based on the core technology
	Product-specialised innovation	Product focus, developing one kind of product to improve its functions; acquisition of highly specialised product patents	- Strengthening patented product development - Enhancing knowledge in-house, focusing on core technology improvement - A strong awareness of intellectual property protection (protecting unique resources)

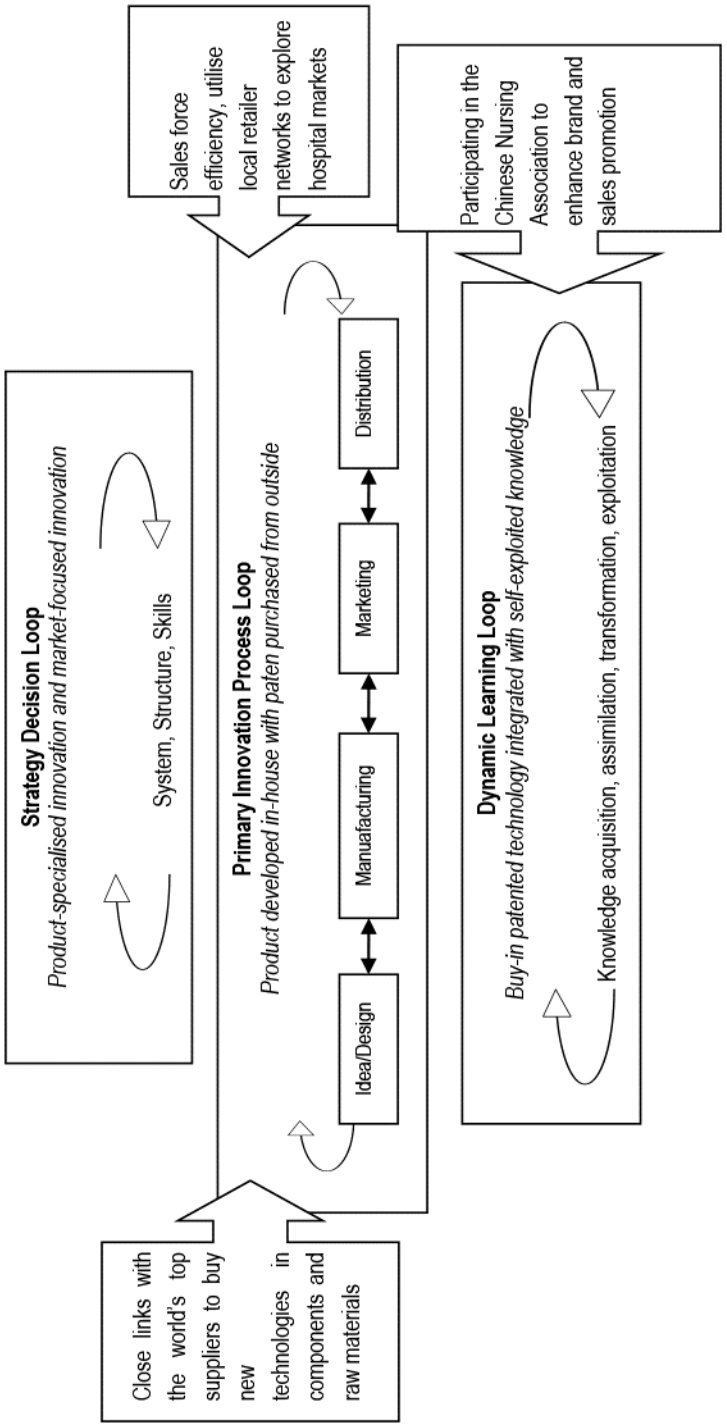

Figure 11. Huize Company Analysis

5.2 Case study 2: Changjiang company

Background

Changjiang Electric Ltd is a recognised high-tech enterprise located at the Phoenix Hill industrial park in the Wuhan East Lake New Technology Zone, Hubei province. It specialises in high- and low-voltage complete power transmission and distribution equipment, systems and solutions. The Changjiang company began in 2006 with no more than 30 employees. After several years of leap-style development, Changjiang now has 600 employees and has become a medium-sized enterprise with more than millions of RMB in annual output value. With a wide product application, Changjiang has expanded its market areas to state power stations, building construction, railways, civilian residences, etc. Changjiang has set up five branch offices in China, such as Beijing, Hunan province, Shanxin province, Inner Mongolia, and Ganshu province.

Changjiang is growing rapidly as a "dark horse" with outstanding profit and performance in China's electrical industry. The company advocates "cultural innovation, technological innovation, management innovation", aiming to create high-quality products to meet user requirements. It has been ranked one of the top three electric manufacturing companies in Hubei province.[8] The company quickly acquired licenses for technology patents, meeting global and national product and quality standards. Changjiang has passed the validation of the ISO9001 Quality Management System and ISO14001 Environmental Management System. Eleven of their products have gained 3C Quality China Compulsory Product Certification. The company has obtained an AAA enterprise credit grade certificate, specific product certificates (high-voltage and low-voltage prefabricated substations) and a high-tech enterprise certificate.[9] Their main products were awarded the 2010 "Wuhan Famous Brand" award. In 2008, Chairman Xincheng Wang of Changjiang Company was honoured as one of the top ten outstanding entrepreneurs in Wuhan. The company's ultimate goal is to become a world-class electrical enterprise. From its inception in 2006 Changjiang

[8] http://www.hbcjdq.com/index.html

[9] http://www.hbcjdq.com/products_list_zz/&pageNo_FrontProducts_list01-00243=2&pageSize_FrontProducts_list01-00243=8.html

has maintained rapid growth. The proportion of sales turnover is more than 40% per year, with total revenue in 2011 reaching 0.5 billion RMB. With the rapid growth of the Chinese electrical sector, Changjiang has gained a large market share and sales. In only six years, it has successfully built its market-leading position in the electrical sector in Hubei province.

Industrial environment

The electrical equipment industry is regarded as a high-tech industry with low entry barriers. In other words, although it is a high-tech industry, it also has a relatively low threshold as a business sector. The start-up capital requirement is not very high and firms can obtain fast returns on investment. In recent years, the tremendous demand in China's electric equipment market has been driven by nation-wide infrastructure construction, and thus, the sector has attracted small private firms flooding into the industry. According to a report from the Wuhan Electrical Industry Association, there were only a few electrical companies in Wuhan city before 1999, but that number has now grown to hundreds. The technological level required by this industry is not very high. There are many incumbents and potential new entrants to the industry. Many small electric companies operate as simple assembly plants without any R&D or product development teams.

Market-driven innovation

Like other small electric manufacturers, Changjiang company started from a small workshop. Their previous major production line involved assembling electronic components into a variety of high- and low-voltage switch transformers. At the early stage, they did not have their own factories or brand; an old manufacturing plant of Changjiang was leased. Under these circumstances, the CEO and founder of Changjiang decided that the company's first objective should be to develop its market and enhance production capacity. The company grew from selling electric products to selling total solutions (electrical equipment installation, commissioning and designing electrical systems, power engineering construction, etc.). With capital accumulated over the years, Changjiang built its own manufacturing plant with advanced production machines

and quality control facilities. In 2011, Changjiang moved into new factory premises where it is now located.

> The industry has low barriers to entry, so many new ventures or start-ups are only the equivalent of a workshop-style assembly plant. They just raise start-up capital, recruiting several electrical circuit diagram designers and a group of assembly workers, rent a workshop and start production. We were in the same situation at the beginning, but we know how to be more professional than other small firms. We have our own technical sophistication to use CAD design systems productively. (Technical Manager)

Changjiang has established a clear market development goal which is commensurate with China's electrical market growth. The market-pull demand mechanism influences Changjiang's approach to new product development opportunities and the company is active in identifying and effecting incremental changes in its product lines and services. As a total solution provider, Changjiang is tailor-made for power engineering projects, its one-stop EPC service including electric design, engineering, procurement and construction.

> In addition to the product's introductory brochure, every member of the marketing staff takes a special book when they are going to meet customers. This book is a collection of all the qualification certificates and manufacturing licences that we have achieved. It fully demonstrates our production capabilities and makes customers aware that we are a qualified company and can manufacture reliable products. (Marketing Manager)

Leveraging its in-depth understanding of the local market and professional knowledge, Changjiang has developed a series of products that are suitable for China's domestic market. Over the past six years, they have been trying to meet various requirements by offering different solution packages to different customers. They believe the best-fit products or solutions can fulfil customer needs.

> We produce customised products rather than developing a radically new one. Customer satisfaction is our top priority. We believe good products are the best for customers. We know the customers. They are looking for simpler, cheaper and better solutions. We can provide optimised total electric solutions for them, from design to production to final installation. We are good at understanding our customers' demands and expectations. The different departments, such as marketing and sales, manufacturing,

> the call-centre, technology, etc., are all integrated for serving our customers. We treat the customers individually; each project is treated differently and labelled with the customer's name. (Production Manager)

Electrical products require high technical integration and a high degree of customisation. Changjiang utilises cross-functional teams to provide services to better meet each customer's needs. The marketing department is closely connected to the technology department and the company's call centre. The different departments work together closely to ensure the delivery of excellent products and services to every customer. The process is laid out below.

First, the marketing staff initiate face-to-face communication with customers to fully understand a user's purposes. Second, the technology department provides a tailored design in accordance with customer requirements, based on the fastest, best and most practical plan and advanced technology. Third, the call centre and technical department will calculate the total cost of the project in a short time and respond to the customer with their best price. Fourth, the electrical installation projects are improved in energy efficiency in accord to the customer's requirements and compliance with national standards and regulations. Changjiang even offers supportive training services for users and gives technical advice to potential customers. The company aims at providing customer-oriented, reliable and safe solutions, and optimal integration components that are broadly suitable for the industrial and non-industrial applications of customers.

> We offer ongoing product and technology support to our customers; for instance, in 2008, we initiated a free follow-up product inspection service for our existing customers. As long as they are our customers, no matter how far away they are, we will go to them. We even went to Tibet to visit customers and check their products. Only our company can offer such comprehensive after-sales services and technical support to customers. No other competitor can do it like us. By providing those services more intensively than competitors, we have won a strong reputation in the market. (Quality Manager)

The company's slogan is "Customer satisfaction is the pursuit of Changjiang; the user's requirements are the responsibility of Changjiang". Quality assurance, best services and technical support are the three cornerstones of its products. Its total quality control approach

covers the entire production process. The best services and technical support include pre-sales, sales and after-sales service. Pre-sale service involves everything that potential users may have questions about, and offering good advice to customers. Sales service means ensuring that product installation and commissioning meet national and industrial standards and the relevant requirements based on customer demands, along with providing professional training to customers. After-sales service is concerned with providing lifetime service and support, including sufficient product warranty for the customers in terms of a one-year warranty, a lifelong customer information bank system, free maintenance within the warranty period, etc. In responding to user questions, 24-hour on-site services and trouble-shooting solutions are deployed as quickly as possible.

> Our company's full name is 'Hubei Changjiang,' which was given by our president. This name indicates his intelligence. 'Changjiang' is the name of China's longest and biggest river and 'Hubei' is our company location. This name is common and simple. The name makes it relatively easy for customers to remember and recognise our products. At the very beginning, it helped a great deal in obtaining customer acceptance and awareness of our product reputation. We knew that brand recognition was important when entering a new marketplace. (Marketing Manager)

Changjiang puts a great deal of emphasis on marketing and hires many marketing employees. Its marketing efforts are focused on promoting Changjiang's commercialisation capabilities and distribution channels. Their "marketing-first" innovation is aimed at capturing more customers, establishing an advantageous market position:

> In the initial stages of our company, we paid more attention to marketing innovation so as to explore the market to survive. In our company, almost 60% of employees are in marketing, with more than 400 in total. Our incentive mechanism is to let everyone demonstrate their abilities. Our market expansion was very rapid, even during the global financial and economic crisis; our company maintained its high profit growth. (Sales Team Leader)

Competition in the Chinese electrical industry is mainly between key local competitors. Changjiang pursues an aggressive marketing strategy so as to reach potential customers. Aiming to expand its market share, it emphasises both the maintenance of current products in current markets

and the introduction of current products to new markets. By establishing a strong connection with both technology and the market, they have rapidly built a strong marketing network and achieved high growth. In recent years, Changjiang has sought to exploit overseas markets, has become involved in international construction projects and exported products to Iran, Guinea and Myanmar:

> Our marketing department has a loose structure that consists of eleven teams. The teams are classified according to groups and team leaders. Each group is self-managing and very flexible. This kind of flexibility has the merit of rapid response to market changes. The marketing staff does not normally stay in the office. They stay close to the market in order to understand customer processes and their requirements. The payment and reward system links individuals to goals. Our individual rewards to sales employees can take up to 60% of the company's net profit. Changjiang provides a platform for employee performance. No company can do it like us. From personal profit maximising to realising the company's profit maximum, that is a win-win situation between salespeople and Changjiang. When marketing employees make money, the company is making money, too. (Sales Team Leader)

According to interviewees, autonomy and task discretion are both allowed in the marketing department. The marketing staff works in teams or individually. Every marketing team is set up with a team leader, and salespeople are free to join in. Salespeople have a certain freedom in choosing sales teams and developing their own leads. The self-organising marketing teams have not only led to marketing efforts in new market exploration and interaction with customers, but also coordinated and managed the progression of different projects. There is a regular weekly meeting of salespeople to share their selling experiences and to discuss how to attract new customers. Moreover, an intra-entrepreneurship mechanism is broadly encouraged in the marketing department, which motivates employees to take ownership within the firm. The company has constructed a performance-related reward scheme for facilitating sales activities. Profit-sharing is an incentive to motivate employees. A salesperson's income is closely connected to their sales performance. Changjiang adopts a flexible salary system. Salaries are divided into three types: basic salary, sales-based bonus and annual salary. The sales staff assign types of salary according to competence. The profit distribution policy is to put employees first. This reward scheme provides

an efficient tool to stimulate the sales employees' potential abilities. Through bonus redistribution, employees can receive a large portion of the company's yearly profit from sales. In some sense, this performance-related reward system is a strong incentive for every member of the marketing staff. It aligns objectives of individual profitability with organisational goals, and therefore, employees and managers are both trying their best to create the greatest possible profit for the company, and this will also achieve their personal goals. With the accomplishment of common goals, everyone contributes to Changjiang's development and benefits from it.

Supplier knowledge-based innovation

In order to keep up with China's electrical market development, technological upgrades are constantly needed. In the inception phase, Changjiang had already realised its weakness, and therefore made efforts to absorb foreign advanced technology. They selected technology-leading suppliers and ensured that those companies could provide high-quality technical support. Those suppliers were globally known multinational companies with leading professional technology in power and automation, such as ABB, Schneider and Siemens. Changjiang communicated widely and cooperated with its world-class suppliers. In 2007, Changjiang signed bilateral agreements with ABB to build up their long-term close cooperation partnership. [10] Such upstream strategic alliances have provided Changjiang with access to the latest advanced technologies.

> In our strategic alliance, we're happy to develop innovation with world-renowned suppliers. We are a complementary collaboration partner. ABB, Schneider and Siemens are all foreign companies with very strong technological capability, but they lack knowledge of the Chinese market and have weak ties with Chinese customers. We understand our customers and the local market thoroughly. For example, ABB authorised us to produce its MD 190 low-voltage switch transformer. We normally select and work with those top suppliers. We collaborate on the BlokSet low-voltage complete switch equipment with Schneider, and on the SIVACON 8PT low-voltage switchgear with Siemens. There is a good trust relationship with other suppliers, too. In fact, two Chinese electrical companies even deposit their products in our company's warehouse. (Purchasing Manager)

[10] http://www.hbcjdq.com/products_list_zz.html

ABB not only supplies products and software, but also offers advanced technologies and after-sales services to Changjiang. The collaborative agreement includes a set of terms: premium price, delivery time priority, year-end profit bonus returns, personnel training, technical communication platforms, and so forth. ABB technical staff comes to Changjiang to train its employees and offer professional technical guidance, providing advanced advice on product processing and design, helping them to reduce costs and minimise waste in production. ABB even joins with Changjiang to participate in open-tender competitions on large-scale electric projects. The collaboration has greatly enhanced Changjiang's product innovation as regards the combination of technology and applications. The strategic partner alignment is also beneficial to both Changjiang and the foreign electrical suppliers, who can more easily enter the local Chinese market and gain greater market share by co-operating with Changjiang. On the other side, close alliances with top suppliers are not only helpful in allowing Changjiang to acquire external technology, but also enable Changjiang to increase its reputation and competitiveness. The strategic partnership has contributed to the company's competitive advantage and rapid business growth.

Talent-centred innovation

Changjiang insists on a "people are the core" policy to obtain, develop and retain skilled workers. Employees are its most important resource. Changjiang places emphasis on an HR strategy to recruit, develop and retain skilled employees.

> Due to the fast-changing environment, we need to have new blood coming into the company. Our company takes advantage of some of the great talent that has just graduated from universities. We hire new graduates and workers with advanced skills every year, and train them to adapt to our company's development. Our leaders think human capital is a key to our success. Company's rapid business growth is derived from high-quality talent. (HR Officer)

80% of the company's employees are under 35 years old. Its HR policy favours recruiting both new university graduates and skilled workers, and nurturing existing human resources inside the organisation. The

talent-centred strategy attracts many promising workers who are fundamental to enhancing Changjiang's comprehensive strength.

> An organisation that doesn't learn will not succeed. Our training input is great. The HR department works out a training plan every month, from weeks to exact dates, including very detailed contents. We have three sorts of training courses that every new employee has to participate in. Beyond the three mandatory courses, we have a self-learning system through our internal website. The e-learning system was purchased from TBC (Times Bright China) Education Development Company. It was bought in order to make good use of self-learning and internal tacit knowledge diffusion. (HR Officer)

A set of training programmes comprises different levels, all aimed to improve the professional competence of employees. The multiple-level internal trainings are divided into three items: pre-job, on-the-job, and off-the-job, all of which have both compulsory and optional training programmes. The compulsory training programmes include courses in "orientation training", "safety training", "company regulations and management training", etc. This is a kind of elementary training, containing an introduction to the company's mission, history, routines and corporate culture, together with basic technical skills and working communication skills. The optional training programmes are arranged by departments, including professional training or project training courses and are aimed at enhancing each employee's particular skills. To achieve enterprise-wide tacit knowledge sharing, a number of training courses are taught regularly by internal senior staff with abundant experience. The senior technical or managerial employees impart their knowledge to junior workers. External training is held two or three times each year. Employees can either go out to attend seminars or workshops or the HR department organises external experts to come to the company's location to give training courses. If an employee obtains a formal education degree based on studies in their spare time, which is relevant to their job, the company covers 80–90% of the tuition reimbursement.

> We do believe that humans can create anything. The new recruits and young college graduates have to work in the workshop for more than a month when they enter our company, which helps new staff gain an in-depth knowledge of our products and get to know our working environment and routines. Employees have to rotate through different

> front-line jobs and processes to gain multiple skills before they receive promotion. The variety of job rotation enables our employees to be familiar with the entire work process and have enough experience to work in any part of the company. (HR Officer)

It is very common in Changjiang that employees take part in job rotation, which offers them greater chances to obtain tacit knowledge and understand the company's routines. In order to foster internal knowledge sharing and diffusion across functional boundaries, an e-Learning IT platform was also established at Changjiang. This type of e-learning is available on Changjiang's internal network. It contains a set of self-study programmes, encompassing various files, videos, animations and a chat window. These database resources include management concepts and tools, marketing skills, self-assessment quizzes and more comprehensive learning packages. As an internal knowledge base, the e-learning tool offers different online courses for the off-the-job training of all employees. Employees can access the online e-learning system and select any kind of knowledge that they need to obtain. They can also make their own comments and recommendations or upload other good practical training courses to the company's intranet. The intranet provides an effective and secure communication platform within the firm. The process of lodging and accessing information over the intranet is interactive. The e-learning system thus increases individual learning as well as organisational learning.

> We paid Yuexiu Consulting Company for consulting services not only to help us to reconfigure our internal management system, but also to offer state-of-the-art training courses for our staff. They guided us in optimising our working procedures, integrating our daily activities and routines into a management discipline. (HR Officer)

In order to improve a less-professional management situation and build a modern managerial mechanism, Changjiang is actively involved in acquiring knowledge from outside. The company signed a three-year contract with Yuexiu Consulting Company in 2009. Yuexiu is a business consultancy and manpower training firm. This company was commissioned to provide professional management knowledge and practical training courses to Changjiang. The managerial solutions are tailored to guide Changjiang in effective management. The series of professional management knowledge, including lean management

knowledge such as about the quality manual, programme files, management procedures and process instructions, cover multiple elements (e.g. production processes, quality control, marketing). By transferring and assimilating external knowledge, Changjiang carried out an innovation activity with which everyone was involved, called "Fine Management" inside the company. The knowledge procurement and the implementation of lean manufacturing methods and techniques have greatly reduced administration and production costs, improving efficiency and total product quality management at Changjiang.

The aim of the company's culture is to empower employees in the work place. Changjiang has set up a spirit of "breathing with Changjiang, growing with Changjiang, developing with Changjiang". By sharing the company's common values and beliefs with employees, the organisational culture closely binds every employee's interests to corporate objectives. Changjiang pays attention to educating its staff about company values, increasing a sense of belonging. There is a heightened connection to the company from top to bottom. Personal career planning is designed in order for employees to think more about their lifelong careers and pursuits in the company. The flexible job design prevalent at Changjiang encourages every employee to determine his or her own career development path. It seems that the working climate makes employees feel more satisfied with their jobs and become more committed to the company. The employees display more self-regulatory and self-corrective behaviours in their jobs.

> Many workers in our company are from the 1990s generation, which brings more challenges to our management. We did much to ameliorate employees' working and living conditions. Our company has a staff canteen and entertainment rooms. On the other side of this building is the staff dormitory. The canteen offers meals with subsidies from the company. Three times every day—breakfast, lunch and supper—meals at a low price bring convenience to the employees. We have a basketball playground in front of the workshop. Every employee can play there after work. We have two company buses for our employees' transportation, which makes it convenient for them to spend as little time as possible commuting to work. In sum, the employees work at ease and live a comfortable life. (HR Officer)

The company has a set of incentive mechanisms and a performance evaluation system. The reward mechanism involves a complex set of

formulas that attempts to take full account of the staff's productivity and performance. The HR promotion strategy aims to nurture staff in long-term commitments to the company. The company has implemented an internal recruitment priority policy, so that important management positions are typically selected from inside. Every staff member generally has equal promotion opportunity in Changjiang. Employees promoted to management positions have been rotated through different jobs and have multiple skills and broad work experience. According to an HR officer's statement, the internal promotion policy directly motivates employee enthusiasm to work. The favourable working environment and fair competition attract more talented people to join the company, especially young people. As a result, Changjiang has accumulated a pool of loyal and skilled employees.

> We held a song competition and a basketball tournament this year. We also organise a gala ceremony for every Chinese spring festival. The performances are all produced and presented by our employees, things like songs, dances, a one-act play, magic, poem-reciting, a fashion show, etc. Furthermore, our company has sponsored trips to different places outside Wuhan for training and exploration, increasing cross-department communication. All those activities enhance the staff's morale and cohesion; it is better for employees to interact with each other and strengthen teamwork. (HR Officer)

Changjiang pays attention to the work and lives of employees. The company advocates a culture that is summed up as "work happily, enjoy life and career success". Many activities organised by the company are targeted to exploit employees' potential ability and co-operative spirit in teamwork. The theme of commitment, collaboration and communication among employees is embedded in the organisational culture. At the same time, the organisational culture creates high levels of employee satisfaction. Changjiang's employees thus have a stronger sense of responsibility and loyalty to the company. This is reflected in the fact that the staff turnover rate at Changjiang is very low.

> Ideas appear from many sources. We encourage employees to come up with new ideas. We have our own internal newspaper; the authors are our employees. The internal newspaper is one of the places that staff can discuss company matters and express their views on them. Our mailbox in the workshop is for collecting idea proposals. It also allows staff to give their suggestions or thoughts to the general manager directly. In fact, the

> employee suggestion system is not new and can be found in many SMEs, but our company implements it in an efficient way. In Changjiang, all employees are actively involved in innovation as their everyday routine. (Production Manager)

Changjiang has tried to establish an open communication environment between workers and management. The interviewee elaborated that there is a strong incentive to stimulate employee creativity and ideas generation. The employees who work in the workshop at the bottom of the company hierarchy are also allowed to interact with top management on ideas which could have a positive impact on the organisation. They can either send their own proposal and advice through traditional suggestion boxes or express ideas and offer reflections directly to top managers. To motivate the employees to come up with innovative ideas, Changjiang has set up financial reward for those who propose good ideas. The recognition and rewarding of innovative suggestions is not fixed, but determined by a manager's evaluation according to the impact of the ideas. Its corporate culture leads to employee commitment, involvement and organisational effectiveness. This all makes Changjiang full of vitality, cohesion, innovation and competitiveness.

R&D proactive innovation

Changjiang's R&D adopts demand-driven technology that functions as a technical support unit in the company. Changjiang possesses CAD/CAM design systems and advanced PDT (Power Design Test) systems. Its technology department has grown from four or five employees to twenty, who are highly skilled electrical engineers and technicians. The technological capability has moved from the introduction of technology to independent research and development. For instance, the self-designed auto-protective control monitor for high-voltage electric products can prevent user error, increasing safety. Their self-developed power compensation technology significantly reduces reactive power dissipation, improving the energy-saving and efficiency of the electric transformers.

Changjiang is also keeping their eyes on next-generation technologies, both inside and outside its industry. After five years of explosive growth, with the company's resources and capabilities already increased, their strategic vision has been adjusted from a market orientation to a more

technological orientation. In order to achieve long-lasting sustainable development, Changjiang is preparing to tap into a newly developing market; smart grid technology has been forecast to be a most promising new technology in the coming years.

> Looking at the situation in China and then at our business model, I feel that our company's strategy is well positioned in terms of competing with rivals. As our company became bigger and the technology got more mature, we started to invest more in R&D. In order to target potential future needs, our R&D innovation will shed light on smart grid electric products. Even so, it is a very new field. We must take a proactive approach to obtain a large number of business opportunities. (Technical Manager)

In May 2009, the smart power grid concept was first noted by China's State Grid Corporation. In August, the State Grid Corporation launched a research and development plan. According to the plan, China's national grid will invest in the construction of a smart grid to the tune of more than 4,000 billion RMB in the coming years. This means that electrical companies involved in various smart grid fields will have a chance to share in the proceeds. China has become the world's largest developer and application of the electrical energy market. According to the founder and CEO of Changjiang, Mr Wang:

> China's electrical industry is moving towards a golden era. With regard to technological evolution, the smart grid will bring the future to electrical companies. The smart grid is moving gradually from the conceptualisation stage in laboratories to the practical application stage. Everyone is facing the same challenges and opportunities in the market, those who first to embrace this technology have greater chances to share this big pie. Our company must act faster than others, and this action should integrate a variety of units in the entire electrical chain.

To keep up with electrical market development and technological upgrading, Changjiang is increasing its R&D input and trying to align closely with two universities, the Wuhan University School of Electrical Engineering and Huazhong University of Science and Technology.

> Our president believes the collaboration with universities will enable Changjiang to explore new product development opportunities. On the university side, many scientific research projects have taken place only in the laboratory and never reach the market. They are also expecting to transfer their scientific achievements to the market. It is very interesting

> that Wuhan University was one of our customers. Right now, we are meeting together to discuss the next steps in future R&D collaboration. Meanwhile, we have assigned a contract for co-R&D work on electrical software with Huazhong University of Science and Technology. (Technical Manager)

In 2011, Changjiang determined its next strategic development direction, new energy products. In the same year, the company intended to invest two million RMB to build an S&T park for the research and development of the smart power grid. The majority of the funding was planned for applied research projects with the universities. The investment in R&D is directly aimed at boosting the company's technological capability. The industry-university cooperation is expected to help Changjiang overcome technology bottlenecks in new product development.

In fact, President Wang plays a pivotal role in the success of Changjiang. His forward-looking vision and previous work experience have helped him to recognise new market opportunities. He has perceived the vast opportunity of the smart grid. Six years ago, he acted on his entrepreneurial foresight to start Changjiang, and then led the company to a series of notable achievements. At this time, he made some important decisions. His risk taking and innovation strategy were based on a synthetic analysis of national policies and the economic situation. He is optimistic about his eventual success. Having a pioneering attitude towards a new technology, Wang has great ambitions to develop smart grid technology. He commented that:

> Keeping eyes on market opportunities, following up on your experience and acting quickly. As a good entrepreneur, I am trying to develop my business ideas to make my company bigger, so I must continue to learn, think and progress. I took MBA courses at Wuhan University. It was a very useful programme. I have used some knowledge there into my business practice.

Changjiang keeps pace with the swift tempo of the Chinese electrical industry's development. It seems that President Wang has a strong sense of innovation and a profound market view. On the basis of a deep understanding of industry specifics, he formed a clear innovation roadmap for Changjiang to build core capabilities at different stages. With his innovative business thinking and steering, he has led

Changjiang from being a small firm to a medium-sized firm within only six years.

Summary and implications

Changjiang is expanding at a rapid pace, growing larger, with a higher level of competition. The performance of Changjiang is far beyond the average level of other firms in the industry. Constant innovation has enabled Changjiang to sustain a growth trajectory for many years. In this case, we can see four major types of innovation pattern. First, the marketing-oriented innovation strategy puts a strong emphasis on markets and customers to capture profits for growth. Second, Changjiang's talent-centred strategy attracts and retains skilled people who provide the foundation that underpins the company's long-term innovation development. Third, Changjiang promotes intra-company knowledge diffusion as well as purchasing knowledge from outside the company to improve labour skills. By fostering a good innovation climate and building incentive mechanisms, Changjiang encourages individual creativity. Fourth, Changjiang look beyond current technology and is proactive in responding to a potential future market.

SMEs use alliance activity to improve their competitive positions (Beekman & Robinson, 2004) in many ways. Changjiang aligns itself in vertical relationships with world-class suppliers as strategic partners for the development of technology capability. Such alliances allow firms to share their experiences in exploring different technologies (Thorgren, Wincent, & Boter, 2012). Upstream strategic partners not only give technology assistance on new product design and process innovation, but also provide world-class training for Changjiang's workforce. Changjiang absorbs foreign supplier knowledge and technology and combines it with its own ability to innovate. Close connections with leading suppliers can speed up product development and reduce development costs. SMEs utilise upstream vertical alliances to access important resources, increase market power and reduce risk, and obtain the necessary technology and expertise (Arend, 2006). SMEs can therefore consolidate and enhance their core competitiveness by cooperating with key suppliers.

Changjiang has a clear long-term focus on enhancing the innovative capability of the company. Changjiang's success is based on customised product design, high quality standards, and novel marketing strategies

that further distinguish it from its competitors. Its market expansion strategies accelerate the commercialisation of products in the marketplace. It transferred its strategic position from that of a product maker to a total solution provider. Their total solutions offer customisation options that meet all the needs of individual customers. Changjiang's marketing capability has been reinforced by understanding the customer's existing and potential demands. Changjiang implements an aggressive market-oriented strategy to expand its market ahead of its competitors, which leads to above-average performance.

From this case, we can see that innovation performance and organisational culture do appear to have a positive relationship. Organisational innovation plays an effective role in Changjiang, which has created a unique organisational identity. There is a desirable organisational culture at the company that facilities employee engagement, knowledge-sharing and teamwork. Changjiang fosters an innovative climate to promote new ideas, high levels of creativity and novel problem-solving competence. The organisational culture greatly stimulates the employees' passion for innovation. Innovation has been rooted in the minds of employee at all levels of the organisation. The staff within the company are empowered to take part in strategy formulation and the innovation process, which means that employees are involved in innovation activities in both idea development and the implementation of innovations. Changjiang offers formal and informal incentive rewards for a variety of innovation contributions. These are significant motivators for employees to make greater efforts, generate more ideas, demonstrate greater teamwork and even train themselves in better skills.

Changjiang reinforces its competitive edge primarily through human resource development. Human resources are a unique competence that competitors cannot replicate (Evans & Lindsay, 1996). Similarly, Johnson et al. (1996, p. 118) note that "firms that are innovative must invest in the skills of their workers in order to incorporate new technologies into the firm and offer new products". In effect, human resources are one source that cannot be learned and copied by competitors. Innovative human resources are a core asset of innovation management and can bring competitive advantages. Changjiang's competitive advantages stem from its highly skilled and committed employees. Changjiang has an active, motivating personnel policy that

includes innovation incentive schemes, an innovation reward system and a mechanism to retain talent. Their internal personal promotion policy helps a superior labour climate to flourish and retains experienced employees within the company. High employee satisfaction leads to an increase in productivity and performance (Patel & Conklin, 2012).

Changjiang possesses a strong learning capability; it acquires and assimilates knowledge internally and externally, and then integrates the knowledge to improve innovation capabilities. Changjiang's learning-oriented culture creates a highly qualified workforce, leading to a better chance of success. The learning is organised in an effective way, including both individual learning and organisational learning. In order to renew and improve employees' technological skills regularly, Changjiang provides multiple levels of work-based training courses, as well as off-the-job online learning. The training programmes are for employee development and to improve employee skills and abilities. Moreover, there is mutual learning within the company. Changjiang established an internal knowledge e-database system that not only increases knowledge diversity across departments but also enhances knowledge sharing among individuals. An organisation cannot create knowledge without individuals, and must support creative individuals to create knowledge in the organisation. In Changjiang, job rotation and systematic training programmes for employees' knowledge development results in more skill-advanced workers than its competitors can boast. It appears that the greater the investment in HR training, the more a firm is likely to achieve a greater number of innovations. Organisational learning encourages individual learning behaviours. In turn, individual learning strengthens organisational learning, which translates into new learning capabilities. In addition, Changjiang organises both internal and external training, provided by a professional consulting company. Small firms normally lack basic managerial skills and experience. To overcome this potential weakness, Changjiang invested in the acquisition of managerial knowledge from outside the company to strengthen its innovation knowledge. Knowledge procurement from external resources has optimised its internal management routines and operational processes. Changjiang benefits from obtaining external innovation knowledge to improve its organisational efficiency. Numerous researchers have suggested that accessing heterogeneous knowledge

contributes to a company's innovation performance (Rodan & Galunic, 2004).

Changjiang keeps an eye on newly emerging technology and is proactive in R&D for future development. Its proactive innovation strategy aims at new opportunity exploration, focusing on market opportunities and emerging trends. The early business strategy of Changjiang was concerned with market orientation. As the company grew quickly, it began to allocate resources to increasing its technological innovation capability. Changjiang established research projects in collaboration with universities. By utilising the fundamental research advantages of universities, Changjiang accelerates the speed of its new product development.

Table 7. Changjiang company analysis

Type of technology in the case company	Sub-category	Theme	Key points in empirical data
Adoptive technology	Market-driven innovation	Tracking and evaluation of market trends, keeping current market and explore new market. Flexibility in responding to customer needs	- Cross functional departments interact with customers to understand their requirements - From providing single product to total solutions - Establish the customer's information base - Integrate total solutions delivery instead of providing single product - Enhance technical support and customer services, visiting customers
	Supplier knowledge-based innovation	Strategic alliance with critical suppliers	- Upstream-led innovation focuses on close cooperation with technology-leading suppliers - Using high-quality suppliers of technology and materials - Strong interaction with suppliers
	Proactive innovation	Focus on market opportunities and emerging trends. Accelerating product development, planning in new product research and development	- Initiate innovation by anticipating emerging market trends - Proactive engagement with technological changes and market development for acquisition of technology, knowledge, know-how.
	Talent-centred innovation	A highly skilled workforce and innovative climate, individual learning and organisational learning. Culture of openness toward innovation, incentive reward mechanisms	- Nurture organisational learning, commit to the development of human capital - Develop the workforce through training, providing comprehensive ongoing training programmes, compulsory training courses and optional training courses - Establish an e-learning platform for employees to learn and share knowledge. - Incentive rewards scheme by using equity interests, profit-sharing and other incentives schemes to motivate staff - Improve employee innovation involvement, encouraging employees to engage in the innovation process - High staff retention to maintain employee job satisfaction, encouraging staff growth consistent with the company's goals - Implementing internal promotion policy and employee job rotation, recruiting new graduates and skilled workers

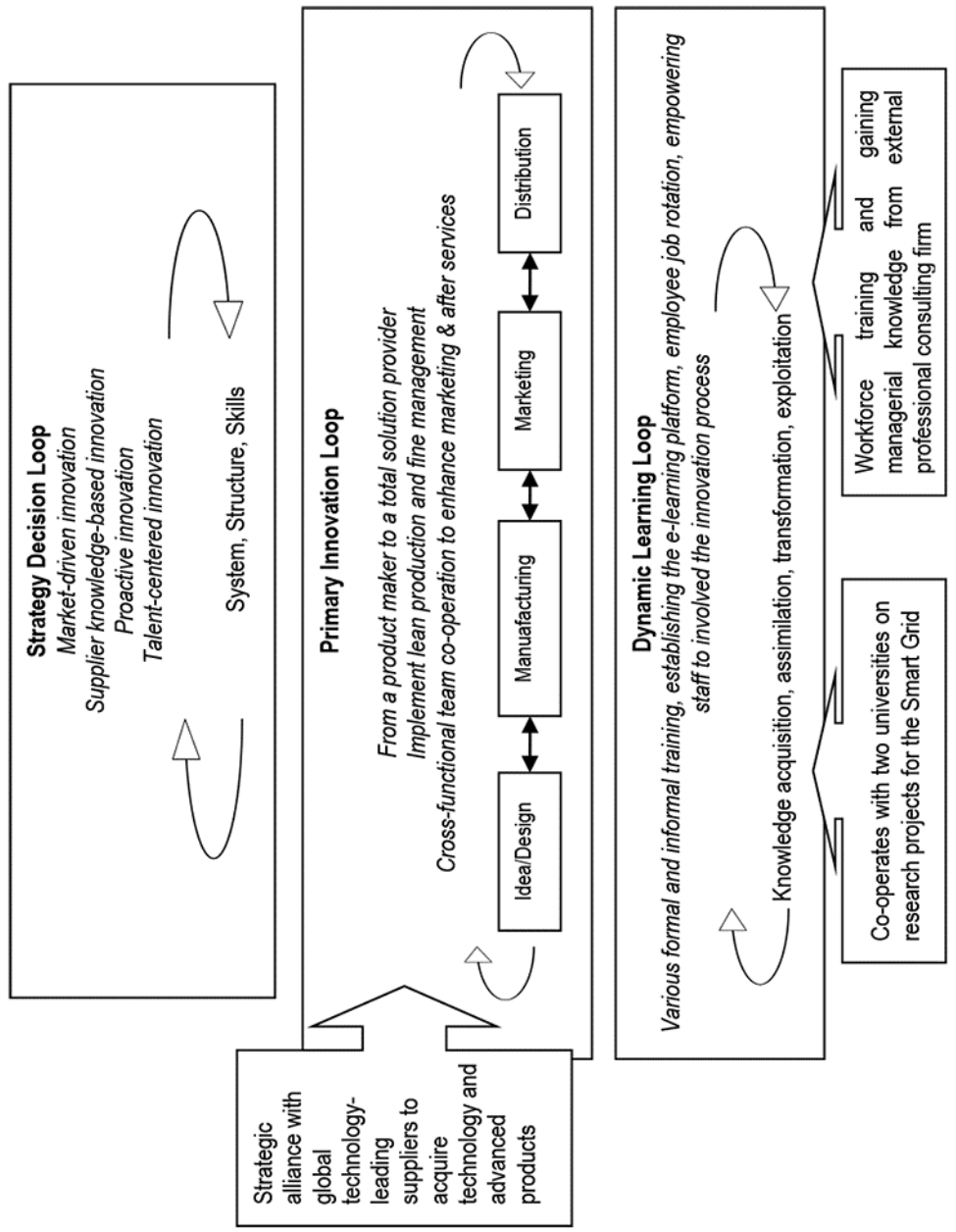

Figure 12. Changjiang Company Analysis

5.3 Case study 3: Xiwo company

Background

Xiwo Electrical Apparatus Co. Ltd is a private investor company dedicated to producing automotive electronic components and accessories. It is located in Shanghai's International Automobile City, in Jiading distinct. The Xiwo company was established in 1996. President Sun is a female entrepreneur who is the founder and president of Xiwo. Prior to starting her own company, she worked in a state-owned electronic enterprise for more than 14 years. Her career change derived from her confidence. She believed that she could run a business better than the one for which she used to work.

Xiwo Company produces a variety of auto microelectronic components, such as vehicle electronic micro-switches, the metal components of cigarette lighters and auto lamps or lights. Their products are mainly supplied to large automotive manufacturers. Xiwo has established long-standing relationships with its customers. Xiwo is one of the first companies to have earned the ISO/TS16949 Quality Management System certificate. Their core technology competencies are in metal elastic material and thermal bimetal that can be widely applied to auto electronic appliances. From 2000 to 2007, the company doubled its sales growth annually. Even in the global economic downturn in 2008, Xiwo maintained 30%-40% sales growth every year. By the end of 2011, Xiwo had 230 employees and a total revenue in excess of 60 million RMB.

Industrial environment

In the 1980s, China had just opened up and attracted foreign multinationals to invest in China. Foreign automakers entered China's auto industry by forming joint ventures with state-owned Chinese partners. China's automobile industry has developed rapidly since the early 1990s. By 2008, China had overtaken the United States and become the second largest automobile maker, and in 2009, China replaced Japan as the world's number one manufacturer of automobiles. China's domestic car market has increased dramatically, as automobile production grew from 2 million in 2000 to over 13 million in 2009. China accounts for nearly 20% of global automobile sales, which is now

the largest auto market in the world. The production and sales of automobiles in China continued to rise in 2010 and 2011. The Chinese market sold 17.59 million vehicles in 2010 and 18.51 million vehicles in 2011, while it produced 18.26 million in 2010 and 18.42 million vehicles in 2011.[11]

The automotive industry is a labour- and technology-intensive industry, including for the numerous small and middle-sized enterprises. The policy of China's automobile industry is "production from local resources for local needs". Nearly all the cars produced in China are made for domestic consumption. The industry has provided the opportunity for many small firms to achieve spectacular growth since the many foreign automobile company joint ventures invested in China in the early 1990s.

Customer-oriented innovation

The fast-growing auto sector created enormous opportunities for Xiwo. The Shanghai Kostal-Huayang Automotive Electric Co. Ltd is a Chinese-German joint venture firm founded by Leopold Kostal and Huayang in China in 1995. Kostal-Huayang supports the manufacture of vehicle parts for carmakers in China, including Volkswagen, Ford and General Motors. In 1999, Shanghai Kostal-Huayang was looking for long-term relationships with new suppliers for semi-finished products and metals, plastics, electrical and electronic components. Xiwo's President Sun was also seeking potential customers. Coincidentally, through frequent participation in the activities of industry associations, Mrs Sun had had a chance to build her personal networks to find market opportunities.

> My prior technical experience in the electronic industry made me think that I could probably do something by myself, starting an entrepreneurial career. So, I quit my job and established this company with 0.5 million RMB initial capital, which consisted of my own savings and loans from my relatives. It was impossible to get loan from banks when your company was very small. In the beginning stages of our company, the workplace and machines were rented at a cheap rate through a social relationship. However, we had no business or customers. The machines were not used for two years, and we hadn't sold a single unit. The situation has changed since I met a key person at a seminar organised by the electronic association; this man introduced business to us. Since then,

[11] http://www.pimchina.com/index.php/industrial-market-insights/the-chinese-automobile-and-auto-components-industries/

> we have been engaged in the automotive industry... For many years, Shanghai Kostal-Huayang Company has been our biggest customer. We produce 700 types of components in total. Just in terms of Kostal-Huayan Company, our product variety has reached 200. (President and Technology Director)

Xiwo Company has many years' mechanical engineering experience, a high degree of professionalism in its R&D team, and a number of senior technicians and skilled workers. Xiwo is expert in metal material and precision module-die designs. The company integrates die-making, automatic spot welding, manufacturing, sampling and tooling. Their processing competence is to meet customer requirements, from R&D trials to small batch production, and to the completion of various prototypes. They continually expand and update their production line by frequently introducing new or improved products to match new car models. Over the years, their products and services have been recognised by large customers. Xiwo has taken over small competitors to become one of the first-line suppliers of auto components to its customers.

> We are making affiliated auto components for large enterprises. We have a good reputation in our industry, and produce better products than the competitors. Our high-quality products significantly maintain existing customers, so that we are keeping our position as a first-tier supplier. We have been working with our main customers more than 10 years; with our mutual alignment of technology and business relationships, we are like strategic partners. Our customers are growing very quickly, and we want to follow these large enterprises to become bigger. (President and Technology Director)

In the automobile industry, vehicle electronic components are developed in partnership with the customers. Xiwo survives in a stable vertical supply chain that supports and follows the developments its large customers. About 80% of the company's revenue comes from mould design and manufacturing, and auto switch assembly. They are reliant on a small number of large customers, mainly supplying three companies: Shanghai Kostal-Huayang Automotive Electrical Company, Shanghai Koito Lamp Company and Shanghai SIIC Transportation Electric Company.

The characteristic of the Chinese automotive industry is a chain-linked production process that ties a variety of firms together. The central large enterprises play the dominant role in the industrial supply

chain, from various metal and plastic materials to the finished vehicle; the process involves multiple independent sub-suppliers. The large automobile firms select suitable sub-suppliers based on their product quality and price. They are interested in obtaining high-quality products at lower prices for volume. Xiwo is in the middle of the automobile production chain. The supplier relationships between Xiwo and its customers are based upon reciprocity and a high level of trust, however, this great trust and mutual reciprocal relations took a long time to nurture and much energy to maintain. This sort of vertically integrated network is bound together to realise common goals, such as reliable product quality, timely delivery and attractive prices. The goal of Xiwo is to meet the needs of large customers to help its business keep growing. Xiwo developed a customer-oriented innovation strategy, maintaining its market share by focusing on existing customers. This strong focus on the current large customers might restrict its scope for innovative activity.

> We are experts in different sorts of functional metal materials. For example, beryllium-copper is a kind of ductile metal that is widely used in vehicle components. Beryllium and copper have different molten points that cause different forces when heated. We give useful technical suggestions to customers about their R&D or new product development, providing technological support, like trouble-shooting. In return, customers give us more business. For instance, this micro-switch device, we produced components for Kostal-Huayang Company to continuing assembly. We are now responsible for designing and assembling the whole part. From manufacturing auto components to auto control parts, this progress helps us open up new and productive territory. Even now, this product brings us millions in revenue every year. (President and Technology Director)

Operating as a subcontractor in the automobile industry, Xiwo is changing with technological developments to satisfy the increasingly specific demands of customers. “Surviving with our customers is fundamental”; based on this principle, Xiwo has been successful in developing products with customers for many years. It keeps technical flexibility on its production lines, accepting small orders, and is able to change and adapt to new production. Being customer-focused, it comes up with technical innovations for special customer needs. Product standards in this industry are evolving rapidly. Xiwo develops products that conform to each particular customer’s requirements. Its

technological standard is compliant with industrial regulations and quality control standards. Meanwhile, Xiwo is also committed to fast delivery and prompt response to customer feedback. Because the company is located within 10km of its customers, the on-site after-sales service takes less than four hours.

> Advanced equipment is essential for innovation in hardware. In order to achieve better competitive advantages, a large proportion of our profit is spent on buying new and advanced facilities. According to customer demands for products, we bought computer-controlled drilling equipment to make high-precision moulds. In recent years, we invested a lot in special-purpose machines for manufacturing, detecting and lab testing, even expensive ancillary equipment. For example, in 2009, our company spent 1 million RMB to purchase a slow wire-cut EDM machine from Switzerland. (Quality Control Manager)

Xiwo has grown to meet the rapid technical changes demanded by the needs of their major customers. They speed up the technological progress and upgrade production equipment. Xiwo produces products especially tailored in order to satisfy the customer's articulated needs.

> With shorter life cycles, all the products and components are manufactured for the customer's wants. Our customers are involved in the product development process. In doing so, a lot of innovations have been affected at the design, production and assembly steps. Our modelling technology is compatible so that it can be applied to a variety of vehicles. We are working closely with our major larger customers to develop innovative new products. Thanks to our customers, who are quite open about their technology with us, we learn a lot from them. Meanwhile, we also share our technology base with them. (Production Director)

Xiwo has invested heavily in R&D to increase its technical innovation capability. Currently, there are ten technical employees on the R&D engineering team. Its annual R&D expenditure is 5% or 6% of sales turnover. Meanwhile, Xiwo not only commits to enhancing product quality, but also produces customised products so as to keep its existing customers. Product development in the automobile industry largely involves chain linkages. The most common situation is that a supplier will meet the requirements defined by a customer in a known product specialisation. In order to serve the top global carmakers in the industry, Xiwo has to update their products constantly for each particular model of

each vehicle. It integrates its critical customers into the product development process and they work together towards constantly creating customer value. R&D involves close interaction with customers before embarking on design and manufacturing. The direction of new product development is spurred in alignment with the requirements of customers. Customers provide samples, drawings or certain technical parameters. The small details of the product are the most difficult part of the design process. Xiwo makes state-of-the-art mechanical designs to fit customer needs. From the design to the sample to the serial products, it always strives to understand its customer's needs precisely and convert those requirements into engineering specifications. By matching its customers' many requirements, Xiwo continually enlarges its product portfolio. On the other hand, Xiwo assists its customers in new product R&D in material selection or joint designs, bringing its sophisticated technical knowledge to this important process. Based on its customer-oriented strategy, Xiwo is gradually solidifying its original equipment manufacturer (OEM) position through the promotion of technological innovation capability.

Cost-efficiency innovation

Cost-cutting is a typical innovation objective of small firms, and Xiwo is no exception. Meeting the needs of their large customers helps its own business continue to grow. Based on strong supplier-customer ties with large firms to achieve mutual benefit, Xiwo has signed production confidentiality agreements (non-disclosure agreements) with every customer. Their current innovation goal is aimed at the improvement of product quality and lowering production costs.

The automotive industry in China is a mature industry that reflects a price-competitive market environment. In recent years, the automotive equipment and accessory suppliers have been confronted with a fierce price war. Many subcontractors have been forced to lower their product prices year after year. Xiwo relies heavily on the relatively few large automobile manufacturers. This dependency can be seen as a double-edged sword. On the one hand, from its close ties with existing key customers, Xiwo can ensure profits that make its life easier. On the other hand, with such over-dependent and stable relationships, Xiwo has paid little attention to marketing and sales opportunities and might have

missed out on broader networking opportunities. As a consequence, there will probably be high costs Xiwo when cooperating with new customers. In this regard, Xiwo has geared up to produce cheap products to meet the minimal specifications of larger firms. The neglect of market development has probably limited its potential for future development.

> As an automotive electronic sub-supplier, we have realised that without our own technology advantages and self-innovation, we cannot work with our customers. The problem involves how to keep costs down and time the technology to the product development. A couple of years ago, we survived by cutting costs through cheap labour, but labour costs are no longer cheap, since the new labour law promulgated in January 2008. The cost of workers became more expensive due to the wage levels going up. Our labour costs have added four kinds of insurance and double time pay on weekends. In recent years, our profit has been squeezed by the prices of raw materials and rising labour costs. Thus, our company has to innovate to reduce costs in other ways. We make value-added products, so at the same time we have to assure high product quality. The quality of our products has been very steady. (President and Technology Director)

As a small auto component producer, Xiwo's competition is intense in the automotive industry, which has pushed Xiwo to become more cost-cutting in the production process. To maintain its low-cost advantage, Xiwo has adopted an indigenous innovation approach of maximising output and reducing unit costs. They concentrate on cost-effective ways to augment profits. By insisting on a quality-first strategy, substantial quality improvement has been made at the design, production and assembly stages. Xiwo incorporates in-process inspection and post-process inspection in its production processes; the on-the-spot quality inspection is executed by supervisors. Meanwhile, in order to realise standardised management, Xiwo has implemented the Six Sigma "6S" system throughout its workshop. The 6 "S"s are "Sort, Set in order, Shine, Safety, Standardise, Sustain". The 6S process management is intended to optimise productivity, minimise defects, and eliminate waste. Xiwo carried out the 6S system to manage the production workflow, including process standards, product standards, procedure standards and working standards. 6S helps Xiwo to increase the effectiveness of its manufacturing process control and reduce the wastage of raw materials. It has become part of Xiwo's long-term strategy for cost reduction and quality reinforcement. Xiwo is now

planning to build up its enterprise resource planning (ERP) system to enhance logistical and supply chain management.

> Our way to deal with rising costs is to improve our manufacturing approaches, optimise work procedures, and find more efficient processes to boost productivity. By doing so, we make a variety of proceeding flow cards in our manufacturing process to standardise production. We calculate how many workers in the process will be realised by higher efficiency. On the other hand, we designed more than 20 tool fixtures to be applied in the production process to cut down on operating procedures, thereby reinforcing productivity. Our automatic rate so far is 15% of the entire assembly line, so there is still 85% potential to maximise our manufacturing automation. (Production Director)

Minimising production cost is important, but competition in advanced technology is even more important. Efficient manufacturing was considered a necessity at Xiwo, so the R&D engineering team tried to seek a solution for improving productivity. Five years ago, Xiwo set up an R&D project for an automatic spot welding machine. Their primary objective for establishing this project was to replace the old manual welding in order to reinforce the efficiency of assembly. The Production Manager of Xiwo explains:

> We invented an automatic two-sided spot welding machine within two years, which was built on the basis of our many years of technical experience and accumulated knowledge. But the first prototype did not work well. The welding failure rate was very high. The welding stick diameter normally ranged from 2mm to 8mm. Our designed machine using welding stick diameter is Ø8mm, but our customer's requirement is Ø4mm. Therefore, the spot solder failure rate was very high at the beginning. We met the difficulties; finally, I made contact with a renowned professor, Cao Biao in the South China University of Technology. In fact, I found his personal information on the Internet. We invited him to our workshop. We accepted advice from him to realise highly accurate welding; he helped us to solve this problem. Additionally, I have been to all welding machine factories in the Shanghai area to talk with technical engineers about welder design technology in details. That is a kind of learning-by-doing process. Then, we recruited four electrical engineers from outside the company to join our design automation team. We worked for around four years to perfect the prototype. Now we are on the fourth generation of the original prototype. The welding defect rate has been minimised to one per million. We subsequently produced nine welding machines that are all used in the manufacturing process; that greatly saves welding time and reduces labour costs. (Production Director)

At the end of 2007, the first prototype of the two-sided spot welding machine was completed successfully. After consulting the metallurgical professor as well as intensive testing, Xiwo achieved a critical technical breakthrough. Following subsequent improvement over several years, Xiwo finally produced nine auto spot welders and applied them to the assembly process. The welding machines are doing quite well in production, offering several advantages. They achieve automatic, mechanised processing of delicate and precise welding, increasing manufacturing speed and cost efficiency. They have eliminated several production steps and minimised assembly time. They greatly reduce the need for skilled workers and save production time. This technological invention drastically enhanced productivity and lowered costs, thus creating a more competitive situation for the company.

> I take care of my employees and am concerned about their most important needs, particularly the key managers of our company. I provide them with a stable job. If managers work in the company for more than 10 years, they get a special bonus or reward. I give money to them to buy an apartment and send them to business courses at Shanghai University. I treat them well. The most senior staff have been with the company for more than 15 years, and they are still working for our company. (President and Technology Director)

Mrs Sun promotes the managers from among senior workers and deploys talented workers in important management positions. This encourages employee loyalty in the company and highly reduces employee turnover. She has built up a cross-functional management team, facilitating innovation activity with the participation of middle managers and supervisors. She places trust in her dedicated team. The accumulated knowledge needs investment in continual learning. She sets out an educational budget to support training for key managers, organising them to take business courses at the university. As a result, most key managers have remained at Xiwo for many years. The most interesting situation is that 75% of the employees have been working at Xiwo for more than 15 years.

> There are not that many female entrepreneurs like me engaged in manufacturing sectors. Many years have passed and I think I am quite lucky, as I haven't run into many difficult situations in my career, and I have always gotten help from someone. I have had a good team for many years. I am an enlightened leader, I allow them to make mistakes.

> Meanwhile, I also feel that my company is short of suitably qualified technologists or higher professionals in the management team. It is quite hard to find someone who can understand both technology and the market. Our engineers have technical experience but limited market views and business acumen and are also not good at communication. (President and Technology Director)

Before establishing Xiwo, President Sun worked as a technology engineer in a state-owned enterprise for many years, gaining rich experience. At Xiwo she acts as both a leader and a technical expert. To broaden her management knowledge, Sun took the Super MBA degree course at Shanghai Jiaotong University. She seemed fully aware of the importance of technological innovation. Technological innovation is frequently discussed and shared at the management level within the company. She plays a direct role in innovation as an initiator of ideas. She leads and participates in the R&D team's work, organising weekly meetings. She decided to invest in the R&D of an automatic machine to realise an indigenous innovation for manufacturing efficiency. In some sense, entrepreneurial commitment to the innovation process and less-structured routines allows Xiwo to keep developing new technologies.

Summary and implications

Two major innovation patterns can be derived from this case analysis. Xiwo maintains a strong customer orientation as its essential innovation strategy. It puts customers at the central position of its business to drive all innovation activities. By emphasising customer needs and satisfaction, it offers its customers valuable innovative products and services. The NPD process at Xiwo is flexible and driven primarily by customer demand. The high level of manufacturing flexibility allows Xiwo to produce a wide variety of customising products. Its innovative activity takes place in close interface with its customers. It addresses the particular needs of existing customers by providing distinctive customer-tailored products. Xiwo takes part in a mutually beneficial industrial supply chain to gain innovative capability and resources from large firms. Systematic integration of large customers into the product development process and learning from them that provides resources for the company's knowledge creation and innovation initiatives. Previous empirical research has found that customers have a positive effect on NPD success and impact the degree of product innovativeness (Salomo et

al., 2003). Customer knowledge is one of the most significant sources of external knowledge for SMEs in their R&D activities. Customers are positively associated with the acceleration of NPD. Moreover, there are symbiotic relationships between small and large firms in the Chinese automobile sector. In order to survive and develop, many SMEs have aligned themselves with large firms by establishing specific technological and business relationships. Xiwo has developed strong ties with its large customers to achieve economic scales that allow them to survive over the long term in the industry. Meanwhile, Xiwo not only serves as the supply base for large enterprises, but also operates within an extensive network of collaborators at both the supply and marketing ends of the product value chain. This could be described as an information- and knowledge-sharing partnership rather than as a customer-supplier relationship. These cooperative supply chain links help Xiwo toward upgrading its own technology and product-specific expertise.

Additionally, Xiwo focuses on the one hand on minimising production costs and on the other on enhancing its capability for innovation to assure future competitiveness. In a fiercely competitive automobile sector, it must innovate constantly. Xiwo pursues a cost-based strategy to enhance process innovations that are mostly concerned with reducing costs and improving production output. Xiwo has been able to make products of high and consistent quality by improving manufacturing processes or uses of new equipment. It highlights process innovations to make operations more effective, improving product performance and lowering costs. Through sustained incremental changes, Xiwo monitors its technological capability to reinforce its productivity. It invents new machines and designs tools to reinforce production efficiency, carrying out a set of new working methods to optimise the production process. Xiwo develops technological capability incrementally, on the basis of its earlier operating experience. Its customised technological capability keeps it above industry-level averages. It pays attention to the development of engineering components and continuous process innovation. By implementing a quality control system and cost-saving solutions, Xiwo maintains its competitive position in a highly challenging marketplace. Xiwo is able to keep up with the pace of innovation and maintain ongoing innovation efforts. It remains competitive in terms of

high quality, competitive price and flexible manufacturing in responding to the needs of its customers.

Table 8. Xiwo company analysis

Type of technology in the case company	Sub-category	Theme	Key points in empirical data
Labour-intensive technology	Customer-oriented innovation	Product development to meet the most stringent customer demands	- Ensuring long-term survival and growth with large customers - Early involvement of customers in the product design and product development process - Increased focus on quality of products by applying a quality control system - Involvement in R&D, design and production for key customers in accordance with end user requirements - Product innovation to satisfy the various needs of customers and delivery time to the greatest extent possible - Links customer value with technology innovation, creating a win-win synergy with customers - Locking in major customers through long-term mutual goals
	Cost-efficiency innovation	Cost-cutting innovation through manufacturing processes	- Minimising production costs and improving product quality - Paying attention to process innovation to reduce reworking and waste. - Adopting new manufacturing methods to optimise production processes and routines - Speeding up technological progress and production equipment upgrades - Invented new weld machine to reinforce production efficiency - Developing novel techniques and designing machine tools to increase productivity

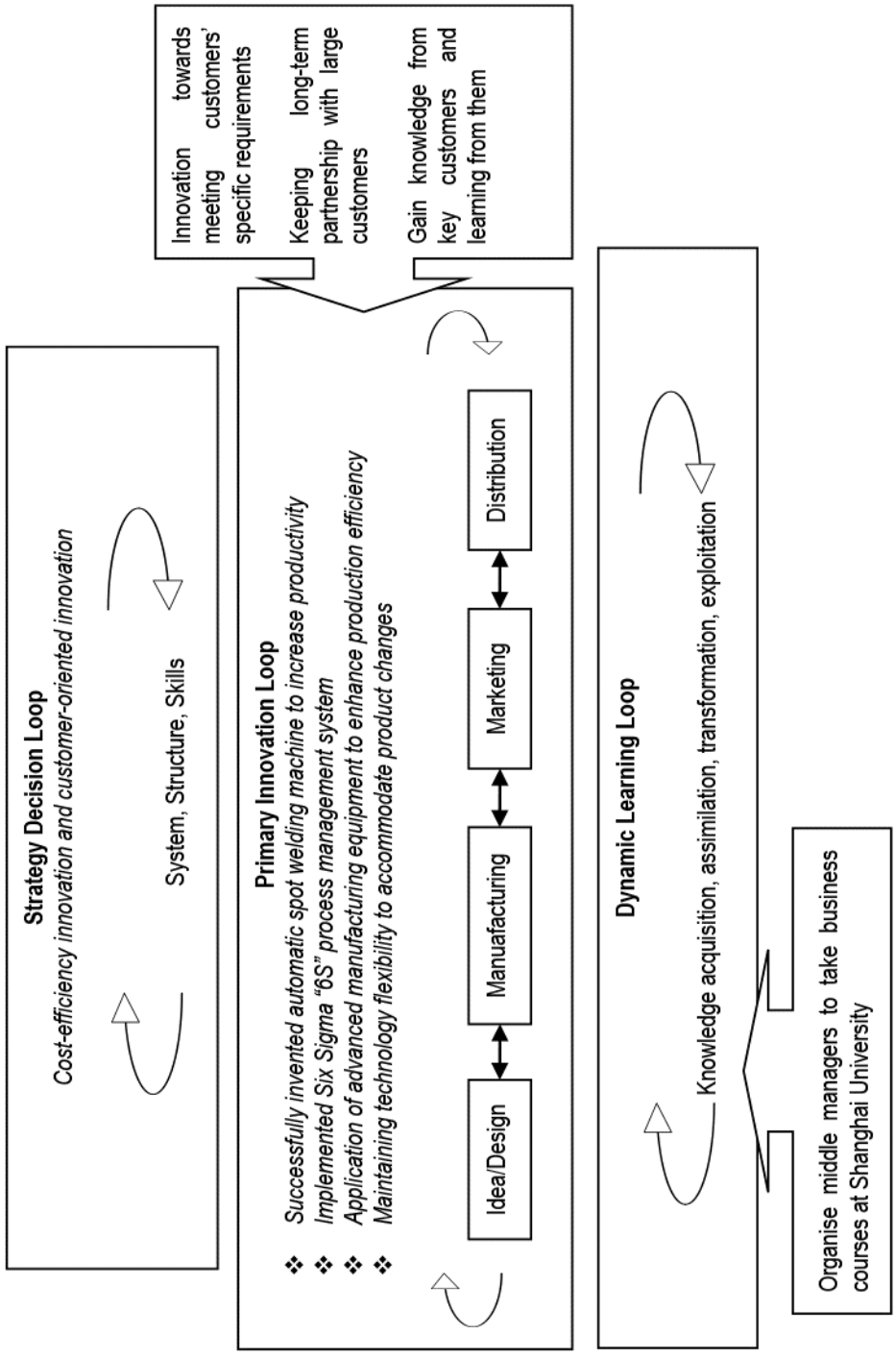

Figure 13. Xiwo Company Analysis

5.4 Case study 4: Leo company

Background

Shanghai Leo Laser Co. Ltd is located at the Optic and Machinery Science Park in the Jiading District of Shanghai. It is a spin-off high-tech enterprise which specialises in high-power laser equipment manufacturing and laser engineering. Its business covers the production of industrial CO2 laser equipment and provides laser processing services in China. Leo was originally founded in 1988 as a joint venture of the Shanghai Institute of Optic and Fine Mechanics & Chinese Academy of Sciences (SIOM) and Shanghai Huazhong Enterprises Group. Leo was established as a spin-off firm, the predecessor of Leo was an R&D laser-application team that was part of SIOM. SIOM is the oldest and largest research institute engaged in laser science and technology in China, specialising in high levels of basic scientific research. The purpose of establishing Leo was to transform scientific and technological achievements into a real productive force. Leo was one of the first producers of high-power CO2 laser equipment in China. Relying on strong and high technology support from SIOM, its major products are 2000w, 5000w and 7000w series high-power transverse-flow CO2 laser equipment. The company owns key technologies and is a professional large-scale CO2 laser equipment designer and manufacturer. It was one of the first series of enterprises to be entitled "high-tech enterprise" in the same industry. Leo was a pioneer and technological leader in producing large-scale laser equipment for industrial applications. It acquired both ISO9001:2000 and ISO/TS16949:2002 quality management system certificates. In the years just before 2004, its market share represented more than 60% of China's domestic market. Its registered capital reached 30 million RMB. Over the past several years, Leo has had its ups and downs, but it was able to develop technologically advanced products. However, it did not innovate rapidly enough to meet market trends. Due to its lack of an explicit technological innovation strategy, Leo gradually lost its competitive position in the laser equipment market. In 2004, Leo underwent an ownership and organisational reconstruction. Later, Leo had a third ownership reform in 2009. Two private owners invested jointly in the Leo company, with 48% of the total assets as the biggest shareholder. 33% was taken by two

technical engineers, who are the current CEO and CTO. The company has had a number of changes and an evolving organisational structure over the past several years. The CEOs redefined Leo's innovation strategy and decided to tap into the automotive sector by providing a laser processing service. Since then, Leo has made rapid progress. So far, its production capacity includes one laser equipment production line and four laser processing service lines, including laser welding, cutting, heat treatment, laser cladding, etc. Leo obtained renewal of its ISO 9001:2008 Quality Management System (QMS) and ISO/TS16949:2009 certificates. In 2011, Leo set up the subsidiary Hangzhou Leishen Laser Technology Co. Ltd. in Zhejiang province, focusing on laser processing services.

Industrial environment

Laser equipment includes small-, medium- and high-power equipment. According to the Chinese Laser Equipment and Processing Industry Report, China's laser equipment market reached RMB3.7 billion in 2010; 67% was high-power laser equipment. The demand of China's machinery and heavy industries for high-power laser equipment is in slight decline, but small- and medium-power laser equipment is expected to keep growing in the coming years. The largest potential demand for laser equipment is in the fields of automobile, semiconductors and electronics. There are approximately 200 enterprises engaged in manufacturing laser equipment in China.

Spin-off technology innovation

Leo is one of the technology spin-off firms from the state-owned research institute SIOM. It is located in SIOM's science and technology park, near its parent organisation. With a strong technology backup force from SIOM, Leo has been involved in a number of scientific research projects: "6.5", "7.5", "8.5", "9.5", "10.5" the National Five-Year Plan and various state-financed innovation projects. Currently, Leo has six shared invention patents with SIOM involving optic-mechanic-electronic integrative technology. From 2008 till 2011, the total R&D input of Leo was RMB6.35 million. R&D input as a portion of turnover was 5% in 2008, 6.5% in 2009, 7% in 2010 and 5% in 2011. There are 11 R&D employees, around 18% of the total employees; two have doctoral

degrees. As far as CO2 laser equipment is concerned, Leo is trying to produce complete products, gradually changing from a single product-focused manufacturer to an optimal solution provider. Its product development intends to integrate the technology of optics, electronics and mechanics, offering one-stop compound manufacturing solutions to customers. It combines different types of electromechanical devices or components together to enable a single machine to perform multiple functions. Its tailor-made design creates additional value to satisfy the technical expectations of its customers. However, those electromechanical devices or components are sourced from other enterprises. Its CO2 high-power laser equipment innovations include: 1) producing energy-saving laser equipment; 2) enhancing electro-optical conversion efficiency; 3) extending the functionality with more specific accessories that offer easy and convenient manipulation.

> Actually, the two key managers who constructed the lead team in Leo came from SIOM; I am CEO and Mr Shen is the Chief of Technology, We are also senior engineers in technology research and development at SIOM. Because Leo is still a small company, its R&D still relies on SIOM. We are in charge of transferring applied technology to the marketplace. (CEO of Leo Company)

SIOM provides direct technology support for Leo's R&D activities, along with technical personnel. The characteristics of the spin-off relationship between Leo and SIOM are complementary and interdependent. SIOM possesses professional advantages in the field of optical science. SIOM has many scientists and researchers and cutting-edge scientific instruments and equipment. As a research institution, SIOM has a research team with strong expertise in specific areas of optical sciences. SIOM has many fundamental studies and research projects that are funded by the state. Their input to basic science research is enormous, but much R&D output is comparatively expensive and not suitable for the market. Leo has a direct relationship with SIOM in sharing knowledge on new product development. Unlike SIOM, Leo is engaged in applied research to translate fundamental science into commercial success. SIOM provides R&D and knowledge support for Leo. Leo is actively participating in a number of practical commercialised research projects. The current new product research and development projects are fibre laser equipment and semiconductor laser equipment. These will be

the new generation of laser instruments for a variety of industrial applications.

In addition to knowledge adding from external expertise and technical personnel, Leo employs two scientists who come from Shanghai Jiaotong University and Fudan University. They are senior professors in electronic and mechanical science and optical science, respectively. The professor from Fudan University is responsible for consulting on optical system design, while the other professor is in charge of experiments on functional laser improvements. The external experts provide professional advice for Leo's technology development.

Cooperative innovation

The automobile industry is a large economical chain system associated with substantial capital and professional knowledge; many different SMEs are part of the industry. As a small enterprise, Leo's operations are based on co-innovation with partners in China's auto manufacturing chain. Consequently, Leo further distinguishes itself from other laser equipment producers in the field of laser processing applications.

> We had developed an innovative approach based on our patented technology. The competitors are developing faster than us in laser equipment production. Therefore, we decided to take action in the applied R&D of laser processing technology. There are more margins in laser processing services compared with laser equipment products, so we expanded our technology capability in the laser processing service business. Currently, there are four laser processing lines that are specially designed for customers in the automotive industry. (Production Manager)

As a complementary technology provider, Leo is involved in a variety of project-based collaborations with other companies. They undertake joint research agreements on laser processing with the large auto manufactures. The first joint technological innovation project was carried out in cooperation with Shanghai Gear Co. Ltd. in 1995. Shanghai Gear Company is one of the suppliers to Shanghai Volkswagen Company for producing gears and belt wheels in its Santana car model. Leo was in charge of offering laser welding for automobile gears and belt wheels. As a consequence, Leo set up a laser processing centre based on its own CO2 laser equipment. Afterwards, the auto belt wheel was replaced by a flywheel. The G3 Fly Gear Project was worked with an industrial partner,

Shanghai Third Gear Co. Ltd. in 2008. Their R&D was focused on laser welding for a double mass flywheel in an automobile engine. The G3 flywheel is primarily applied in middle- and high-end cars. Based on market anticipation studies, the demand for this flywheel was estimated to reach 1.2 million by 2015. Accordingly, Leo has expanded and upgraded its laser processing lines for G3 flywheel services.

> We are working together with our customer-partners at technical exploitation, transferring innovative R&D activities into commercial success. We provide a laser process engineering service to Yi Feng Machinery Factory for the PXE piston. This sort of piston is used in the SPV 716 auto air conditioning compressor made by the Shanghai Sanden Behr Company. Our laser processing service is well matched to market needs. We develop through our supply chain channels, through our partners. (Technology Manager)

Another R&D joint project was undertaken with Tongxiang Yifeng Machinery Factory Ltd. Yi Feng Machinery produces the PXE series of pistons. This sort of piston is a final supply component for the Shanghai Sanden Behr Automotive Air Conditioning Co. Ltd., which is a producer of automobile air-conditioners. It is a joint innovative activity with other firms under the direction of a large central company. The piston is a core component of automotive air conditioning compressors and automobile electric controlled compressors. This type of compressor is used on vehicles powered by new forms of energy. Leo was in charge of providing the laser processing service for Tongxiang Yifeng. The important manufacturing procedure involves welding the aluminium parts of the piston. Lasers are excellent tools for welding thin materials. Laser fine welding on aluminium alloy is a new technology that has been in China for only a decade. Leo began to exploit the technical possibilities of using a new power laser source and new methods of precision welding. The collaboration has improved laser welding technology in aluminium-alloy pistons. Leo engaged in fine welding technology development and its customer-partner specialised in producing compressor pistons. They co-developed a piston to match up with the end customer's requirements. The new piston products are a creative combination of innovation achieved by collaborative research. Its innovative activities are extended across the industrial supply chain. In December 2010, in order to be closer to the Yifeng company, Leo built a secondary laser processing

plant in Hongzhou in Zhejiang province. Yifeng also invested 20 million RMB on a piston production line. The collaboration grew from joint R&D projects to a greater commitment and investment relationship based on mutual goals and trust. It created a win-win situation that benefits both Leo and its partners.

To increase R&D input, Leo raised investment capital through public sources from 2005 to 2007. The company has received a total of 0.9 million RMB in SME technology innovation funding from the National Ministry of Science and Technology. Simultaneously, Leo invested approximately 4 million RMB on this technological innovation project. The name of the joint R&D project was "vacuum in deep penetration welding technology of high-strength aluminium alloy". The laser welding technique was developed completely by Leo. The research is concerned with the fusion welding of thin alloys, minimising distortion of alloys and offering high levels of stability and high welding speeds. This laser welding provides considerable advantages, causing significantly less distortion of metals on the surface and joining components tightly. This kind of technology changed the conventional laser welding method that had already reached a high level in terms of quality and productivity to a level equivalent to that of the global leaders in this highly specialised field. Previously, automobile air conditioning compressors were dependent on imports. It was one of the technological shortages in China. Leo brought new approaches and technologies to this field. Due to superior improvements in this sort of technology, Leo won second prize in a science and technology development award made by the Jiading district government in Shanghai.

> We have a pleasant relationship with local authorities. In recent years, we have won many S &T prizes. Those honours are like free advertisements for our brand in the industry. The image of our company has been improved. Currently, we are building our new subsidiary in Hangzhou. Constructing a new factory requires a huge financial investment. We need sufficient capital to support our business development. Although we have received government innovation funding in the past two years, we hope to get more support from them. We received the "Eagles Plan" from the local government in 2012, which is a kind of bank loan subsidy for small firms. (Office Director)

Leo maintains good relationships with local government departments and actively seeks multiple sources of government support for its

innovations. In order to obtain additional financial resources, Leo actively applies for a variety of government innovation grants. The Leo subsidiary has a bank loan subsidised by the local government for investment in a new plant and equipment. The additional financial support allowed Leo to continue its innovation activities in R&D and to expand its market. Moreover, through networking with the government, the company's reputation has been strengthened in the industry.

Service-related innovation

Before 2004, Leo concentrated on the production of high-power CO2 large-scale laser equipment, but they did not act promptly enough to respond to a fast-changing market and emerged with no new products. Due to insufficient marketing endeavours and offering only one sort of product, its laser equipment business was gradually declining. Meanwhile, newcomers and other rivals were growing rapidly. Leo lost its technological leader position and first-mover advantages in the Chinese laser market. From 2004, Leo had to adjust its development direction and soon this after the organisational structure was reconstructed. Two senior technical engineers from SIOM who have partial ownership became Leo's leaders. The CEO and CTO reformulated Leo's new business strategy. First, they selected the automotive industry as a target market. Second, they redefined their business direction by shifting from laser equipment production to laser processing services. Third, they emphasised close cooperation on R&D projects with partner-customers to transform high laser technology into commercial success. The company's innovation plan was to differentiate itself from the many other laser companies in China. Since then, it has focused its efforts on profitable laser processing services.

> Due to a lack innovation and market orientation in the past few years, we missed the expansion opportunities in the laser equipment market. We failed to develop new products, particularly in terms of connecting technology development with market demands. We learnt from our past mistakes. If we didn't innovate, we couldn't survive. Afterwards, we had to change our innovation and development strategy. The laser processing services bring in most of the sales revenue. So far, the demand for laser processing applications is much greater than it is for laser equipment. There are higher profit margins in the laser processing service business. It offers a better market opportunity and high returns. (CEO)

After a strategic business transformation, Leo's core technology and spin-off intellectual property has been developed successfully. In recent years, Leo has offered more laser processing services than laser equipment production. The company's patents are based around the application of laser engineering. Their automated welding processes can be customer-tailored to serve the local automobile industry. According to customer requirements, Leo undertakes exploitation research into laser processing, offering a wide range of laser processing services to the automobile manufacturers. Their laser processing services include laser welding, cutting, heat treatment, laser cladding, etc. The core technological capabilities of Leo are the laser processing of aluminium welding and gear heat-treatment. Over the past five years, 80% of profits have come from laser processing services. By the end of 2011, Leo had completed laser manufacturing on 8 million work pieces, realised revenue of 50 million RMB and had a net profit of 2.5 million RMB.

The field of laser processing technology is still relatively new, with great market potential. There are only a few players focusing on the commercial applications of laser-related processing services. Leo has exploited a new business area with its unique technological competitive advantages. In this sense, the laser processing service has opened up new market opportunities for Leo. Leo provides customers with the most cost-effective and optimal laser engineering solutions. It is currently involved in four R&D projects focused on a wide range of laser engineering services, such as non-vacuum electron-beam welding, thin metal sheet laser welding. At present, they are in contact with a military organisation responsible for a new project in defence science. It is a laser cladding repair project that aims to use lasers for surface cleaning and polishing to remove corrosion from guns. It seems very likely that it will win government contracts in the coming years. The laser processing service business has become a major growth point for the company.

Summary and implications

The findings indicate three types of innovation patterns:

1) Spin-off technology innovation: Leo enhances its own technology capability by using spin-off resources, transforming spill-over knowledge into commercialisation.

2) Cooperative innovation: Leo has developed close cooperative relationships with its key partners on the basis of joint-research projects.

3) Service-related innovation: Leo diversified its business by stepping into the laser processing service area.

Leo has many technical innovations regarding the smart combination of spill-over technology and specific commercial applications. Leo endeavours to commercialise scientific research, converting laser science and technology into viable laser products or processes for the automobile market. It carries out a great deal of development between basic and applied research. By using spin-off technologies, Leo develops its technological capability in the earliest stages of the laser field. Technology support and technical personnel from the parent research institute are the two key reasons that Leo can preserve its technological capability leadership. The degree of technology transfer from the parent organisation can be safely assumed to contribute indirectly to the development and more rapid growth of the spin-off (Roberts, 1991; Pérez & Sánchez, 2003). By focusing on applicable technology and market gaps, Leo utilises sophisticated spin-off knowledge to address unmet market needs and thus improve its own competitiveness.

An innovation strategy should be set according to an SME's reality, situation and industrial characteristics. Leo made strategic changes when its laser production business lost competitiveness. Leo distinguished itself from its main competitors by offering a unique laser-related service to address the needs of only a few customers. By filling an identifiable small niche, the company has successfully facilitated the development of innovation capabilities in a new business area. The innovative transformation brought more market opportunities. The move from laser production to the laser process service reflected its innovation flexibility. High flexibility allowed the company to shift from product innovation to process service innovation. Enabling flexibility to address market demand diversity, Leo is extending its laser-based processing services into a wide range of industrial applications. When expanding into new products and services in an emerging market, the speed of innovation and organisational flexibility are critical (Tushman & O'Reilly, 1996). In sum, the flexibility and ability of smaller firms to recognise and act on business opportunities quickly has been acknowledged as very important for the innovation process (Thorgren et al., 2011). Furthermore, at

different periods in each firm, the organisational structure needs to be tweaked or even revamped according to the changed innovation strategy. Its restructured organisation enabled Leo to react quickly in order to take advantage of new opportunities and respond to new challenges.

New innovations can be created based on cooperation. By co-innovating with industrial partners, Leo has been successfully transferring innovative laser-related solutions into market opportunities. Cooperative innovation as an innovation mode in which the firm partners with others in the new product development process enables firms to develop their own competence in technical matters. Leo is involved in various joint projects with other companies by providing laser processing services. They adopt a complementary position relative to the major auto manufacturers. By carrying out collaborative R&D projects, Leo has built up intensive collaborations with industrial partners throughout the manufacturing chain. It has developed from project-based cooperative relationships to longer term co-development relationships. Their co-evolution of technology not only increases the speed of R&D development and reduces development costs, but also realises the value of co-creation to meet the particular needs of specific end users. The close cooperative action has a strong market orientation, which directly translates innovative ideas into successful commercialisation. It ensures that the output of technological innovation is linked to market demands. In sum, Leo uses all its different resources fully to make laser service commercialisation realisable. Collaboration enables Leo and its partners to bring new products and services to the industry more rapidly. Partnerships and connections may also help the firm through cooperative efforts which lead to joint development and launch of new products and services, thus bringing innovations to market more quickly (Uhlaner, van Stel, Duplat, & Zhou, 2013, p. 584). Complementary innovation ties across a range of manufacturers within the industrial value chain can achieve win-win innovation outcomes. Furthermore, innovative cooperation may enable a small firm to improve its strategic position, focus on its core business, and cope positively with rapid technological changes.

Moreover, as many other SMEs, Leo is constrained by limited financial resources. Leo maintains good political connections with the local government, which allows Leo to gain innovation funding from

national and local governments for technical work and capital investment for the plant and equipment. Compared with large enterprises, SMEs have fewer financial resources and poorer access to external financing, but Leo is active in seeking the relevant government information, applying for R&D project support and utilising financial funding from governments. By maintaining connections with government officials, Leo has an opportunity to obtain government procurement contracts for laser engineering for the military. Relationships with government authorities are recognised as the most important social resource (Peng & Luo, 2000; Li et al., 2008).

Table 9. Leo company analysis

Type of technology in the case company	Sub-category	Theme	Key points in empirical data
Spill-over technology	**Spin-off technology innovation**	Technology transfer from the parent organisation	- Technology links with the parent research institute - Utilise sophisticated spin-off technology to address unmet market needs
	Cooperative innovation	Functional collaboration innovation with industrial partners	- Co-develop joint complementary R&D projects with customer-partners - Produce optimal laser engineering solutions, integration of customers into the innovation process - Co-existence of large and small firms in market niches
	Service-related innovation	Innovation in processing service to find new markets and customers	- Shift from producing laser products to offering laser-related services - Bring laser process technology to new applications in the automobile industry - Incorporate its own technological strength with market situations

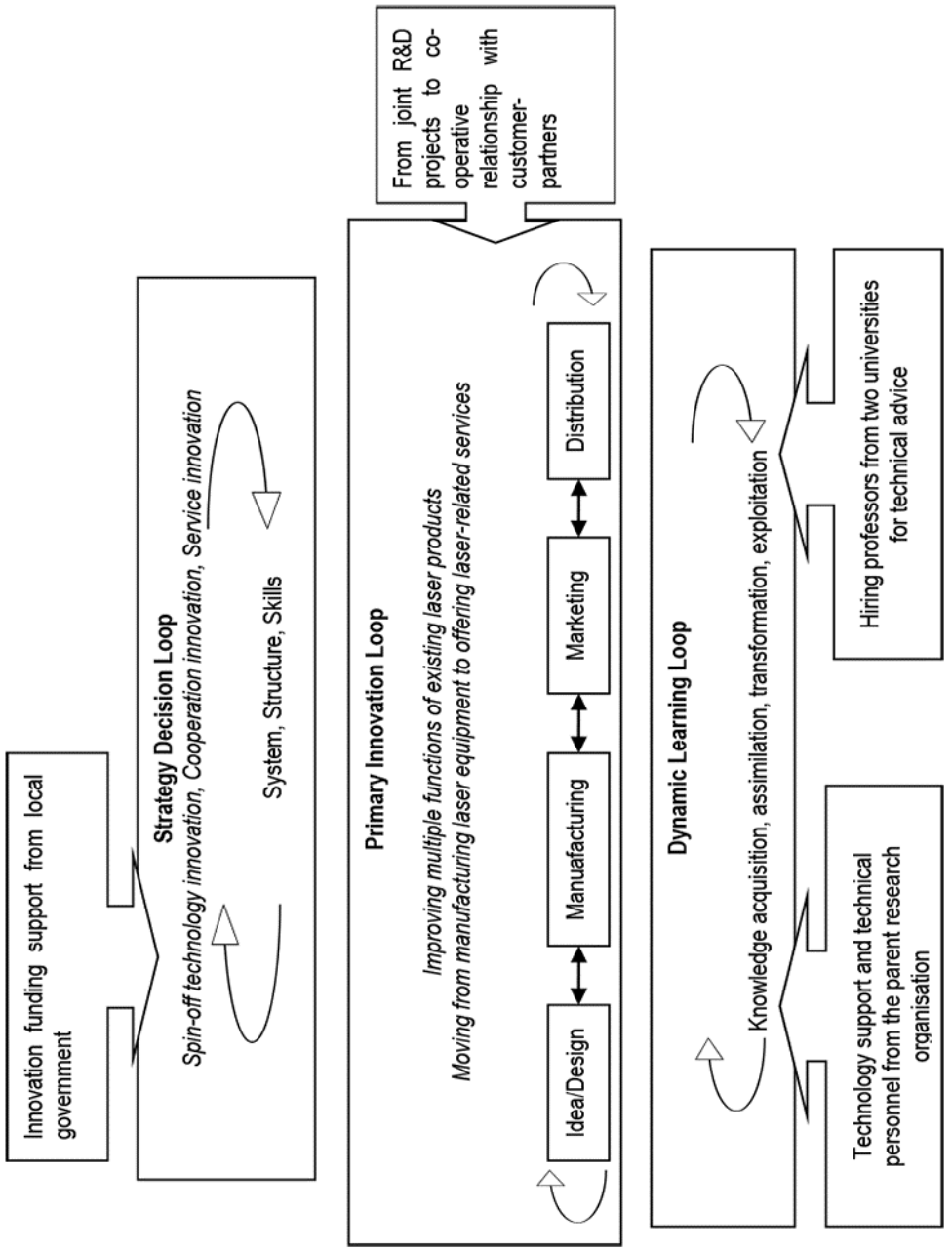

Figure 14. Leo Company Analysis

5.5 Case study 5: Win-all company

Background

The Win-all company was established in 2002; it is located in the Hefei High-tech Zone in Anhui province. It is a high-tech-oriented enterprise in China's seed industry. Its business is mainly engaged in high-yield, high-quality seed R&D, breeding and marketing. Win-all is also the one of main suppliers of super rice seeds in China. Its main product lines are middle- to late-season rice seeds and three- to two-line hybrid rice seeds.

Win-all has a certain capability in R&D, product development, and self-innovation. It is a typical technology-oriented firm. Win-all has an innovative product development capability with outstanding research strength and research efficiency. The company has its own research centre and standardised seed laboratory. Its scientific parental breeding bases are located in Anhui and Hainan provinces. By the end of 2011, Win-all held 14 patents (one invention, one new utility, and twelve new designs), nine licenses for new varieties of plants, and seven national- and 16 provincial-approved new seed varieties. Win-all has passed the ISO9001 (2000) quality control examination and obtained the certificate of good standard processing firm from China's National Standard Management Committee. Win-all's leading product is the indica type two-line hybrid rice labelled "Two Excellent New 6" as a breakthrough product innovation. It has been recognised by the Ministry of Agriculture as "the first demonstration variety of super rice" in China. The spiritual slogan of Win-all is "the sun rises every day, we work hard every day", which implies that Win-all is committed to innovation and makes it happen as part of everybody's day-to-day work.

With a competitive advantage in an innovation-oriented technology, the Win-all company has rapidly established a stable market base in China. According to the China Seed Association, Win-all has greatly increased its market position in recent years. Their market share rose from 0.85% in 2006 to 2.21% in 2008, rising from No. 23 to No. 6 in the country. After several years of super-high growth, in May 2010 Win-all was successfully listed on the Shenzhen Stock Exchange Market, becoming one of the SMEs on the Growth Enterprises Board (GEB). The company's current development strategy is to diversify through cross-boundary mergers and acquisitions. In 2011 alone, Win-all acquired

seven seed companies to expand the scope of its business and increase competitiveness. Its seed products have extended to rapeseed, cotton, melon, seeds of various vegetables and other crops. Win-all is currently growing into one of China's leading seed companies, with eight national-wide subsidiaries.

Overview of China's seed industry

Rice can be divided into several types, such as indica and japonica rice, early rice, middle rice and late rice, ordinary rice and high-quality rice, regular rice and hybrid rice, single-cropping rice and double-cropping rice. Hybrid rice technology can significantly increase rice yields over ordinary rice. The heterosis or hybridity is generally not saved for subsequent generations. In other words, "hybrid vigour" does not keep; the superior hybrid vigour or heterosis features will all disappear in the next generation, and farmers must therefore buy new seeds every season. The seed industry provides seeds for agriculture, commits to scientific research into the key original seeds and strives for propagation of the original species. Hybrid seeds are more expensive than ordinary seeds.

China is a one of the largest agricultural producers in the world, and it consumes around 12.5 billion kilograms of seeds each year. China's seed sector is an emerging industry with an enormous market potential valued at approximately 90 billion RMB. Compared with agriculture in developed countries, China's seed industry is at the early stages of development, with the highly advanced varieties in especially short supply. The well-known multinational foreign seed companies have gradually entered the seed market in China with strong capital, research and management advantages.

The history of China's seed industry

China's seed industry is a high-tech sector of vital economic importance. In the 1970s, China successfully bred stable three-line hybrid rice. In the 1990s, China created a two-line hybrid rice based upon three-line hybrid rice, an innovative breeding technology unique in the world. China's research and development of genetically modified crops has the support of national policy, especially the national "863 Plan project" and the "National Transgenic Plants and Industry Specific Project".

China's seed industry has gone through three development stages, from planned economy, to market-oriented reform and opening up, to high-speed development. First stage was "the planned 'four independent and one complementary'" period (1949–1977), in which seeds were mainly dependent on agricultural communities' self-breeding, self-selection, self-retention and self-use, supplemented by a national adjustment. China's seed breeding system was structured in three levels; there were seed centres at county level as a core, agricultural communes and brigade seed fields as a bridge and seed production teams as a base. That form sped up agricultural crop variety breeding and promotion. The second stage was "the reform and opening up of 'four modernisations and single supply'" period (1978–2000), in which the production of seed varieties had a regional layout. It included seed producing specialisation, seed processing mechanisation and seed quality standardisation, with the implementation of the county as the lone unit for providing seeds. It marked the transformation of seed production from traditional agriculture to modern agriculture. The third phase is "the market stage of economic development" period (2001–present); with the Seed Law that was promulgated in 2000, the seed market saw free competition. All kinds of entities participated in seed competition equally. The Seed Law encouraged various seed firms to focus on R&D self-innovation or purchasing crop variety rights from other scientific research institutes. This period became the foundation of R&D channel diversification and seed diversification. By implementing a regulation protecting new varieties of plants, the government is encouraging R&D into new varieties of plants. The seed companies have gradually been becoming a mainstay of technological innovation.

First-mover advantage

Win-all was founded in 2002, just as China's seed market was opening up and not long after the Seed Law issued in 2000. Private firms were permitted to enter the industry, which at the time had low barriers to entry. The reality of the Chinese seed market was low competition and an oligopoly of a few state-owned firms. Many entrepreneurial or small seed companies had not yet established a stable production base, lacked advanced technology and were short on investment in R&D. Many seed companies obtained their seed breeding knowledge by purchasing

knowledge or through cooperative R&D. At that moment, China has more than 400 government-run R&D institutions and laboratories engaged in seed breeding science and technology innovation. They concentrated on scientific research that was difficult to convert into market-oriented, large-scale operations due to the institutional system restrictions. After the Seed Law, China's seed sector appeared a low degree of industrial concentration. The majority of enterprises were small-scale seed operations. A number of joint venture enterprises emerged quickly. Win-all's first-to-market action was triggered by the emergence of new markets under the new law.

Although the competition became intense, private enterprises were the main players in China's seed market. In August 2004, China's Seed Law was amended so as to raise the barriers to both exit and entry in the seed industry. Through the growth of the agricultural market and national policy supporting its efforts, China's seed industry became more competitive and continues to aggregate. Those changes eliminated many small firms who did not have sufficient technological competence. Only large-scale seed enterprises or those with strong R&D capabilities can survive. The first-mover advantages allowed Win-all to capture new market opportunities at the earliest stages. Its early commitment not only achieved a lead time advantage over competitors, but also made it difficult for competitors to replicate Win-all's success. Win-all was in a better position and increased profits followed, along with market share and R&D funding from external sources.

Supportive agriculture policy

Seed is the most basic production unit in the agricultural chain. High agricultural production capacity relies on agricultural technology innovation and transformation capabilities. The development of the seed industry in China is closely related to policy support. High-quality seed enhances agricultural productivity, and China has implemented laws and regulations to encourage the best possible seed industry for the country. Under China's 2006–2020 food development plan, the Ministry of Agriculture continues to organise and implement seed projects, enhancing the protection and breeding of crop germplasm resources and a national crop breeding base to ensure the ability to supply high-yield varieties, with special focus on the promotion of new super rice varieties.

The development of the seed industry is related to agriculture, food security and national stability. China has issued a series of policies and regulations to promote the development of the seed industry. The National Economic and Social Development Five-Year Plan aims at reinforcing agricultural production capacity, improving agricultural technological innovation and transformation capabilities and accelerating the construction of the National Agricultural science and technological innovation bases and regional agricultural research centres. In recent years, with the deepening of reform, the government has put more focus on basic, public-benefitting and future-oriented crop breeding technology research and development, promoting technology transfer and training and steering agriculture S&T and R&D towards commercialisation. The state is also taking into account the current competitive situation in the international seed industry.

> We benefited from the policy of 'seed law' in our new start-up. The hybrid seed is a very high-margin product. We enjoy a state-supporting policy and have a tax exemption on seed products. New legislation encourages the transformation of scientific research outcomes into market realities. Undoubtedly, it has provided a perfect opportunity to us. (Former Vice President)

In recent years, the central government has emphasised agricultural investment, increasing its support to the national strategic level. The state finances direct subsidies to grain farmers. In 2007, 6.66 billion RMB in subsidy funds was spent on six types of crop seeds: high oil soybeans, high-quality rice, wheat, corn, canola and cotton. In 2008, the State Council decided to add an additional 5.0 billion RMB seed crop subsidy to the budget arrangements on top of the planned 7.07 billion RMB, expanding subsidies for rice, wheat and corn. Increasing the high-quality rice seed subsidy to 2.3 billion, adding 4.4 million acres of rice varieties to rice subsidy all round country, the total subsidies for rice reached 6.17 billion RMB in 2008. In 2009, the central government further increased seed crop subsidies, implementing full coverage of seed subsidies. In June 2009, the State Council promulgated a number of policies to accelerate and promote the development of the bio-industry. This represented the state's desire to see the bio-industry become a pillar industry among high-tech fields and the country's emerging strategic industries. The Win-all company has been involved in state-supported

R&D projects and received government financing for new hybrid seed R&D. This increased government support has helped to foster the emergence of agricultural biotechnology research and marketing in China.

In recent years, China's seed industry has seen unprecedented prosperity: 1) industrialisation and commercialisation have accelerated; 2) market capacity is growing quickly, with the corn, rice and vegetable seed market accounting for 70% of the total capacity; 3) the industry is centralising rapidly. In 2006, 10 seed companies had 20% of the market share. Competition in China's seed industry has shifted from earlier contests over sales territory and customers to being increasingly focused on continual innovation in crop varieties technology. Driven by internal and external demand, the hybrid rice seed market space continues to expand. China's hybrid rice acreage has remained stable, but there is still much room for development. Domestic hybrid rice in 2010 reached 10.1 billion RMB of the market value. Meanwhile, Asia, Africa and many Latin American countries are showing rapid growth in demand for rice, which provides a broad market for Chinese hybrid rice seed in the long run. With the price of hybrid rice seed increasing, it expected that the 2030 market value for domestic hybrid rice will reach 39.2 billion RMB, a gain of more than 250% from 2010. The period around 2009-2010 saw a new round of intensive seed industry support policies. The seed industry consolidation process is expected to accelerate in a new round of industry reshuffling. Win-all used government support policies fully to develop its business.

Entrepreneurial initiative

Win-all's goal is based on a clear vision and steered by the leader's strong ambitions. Haiyin Zhang was an initial founder and was a former leader of Win-all, before which he was a director in the state-owned seed enterprise, Fengle Seed Co. Ltd. in Anhui. With more than 30 years work experience and a deep understanding of China's agriculture situation, he foresaw China's seed industry future and opportunity. In order to continue to contribute to China's agriculture, he decided to start a new business venture after his "retirement". At age 64, he united with Chengquan Li for this purpose. Mrs Li is a well-known agriculture expert who was the former president of the Academy Agricultural Institute in

Anhui province. She was also the key person in charge of a national super rice breeding project. She has strong social ties with the science community. Mr Zhang and Mrs Li had the same dream, to contribute to China's hybrid rice development and benefit more farmers. In July 2002, the Win-all High-tech Seed Research Institute was founded and then transformed into today's Win-all Hi-tech Seed Co. Ltd. These two top leaders of Win-all, one an entrepreneur with management experience for many years and the other an eminent scientist with a strong academic background and expertise in rice researches. They were a highly complementary match and a perfect combination of scientist-entrepreneur, the aptly called "golden partners". Mrs Wang was responsible for the technological and academic R&D aspects and Mr Zhang was responsible for Win-all's business management and overall strategy.

> Our goal was to make hybrid seed products commercially available, moving from the laboratory to the market. The innovation strategy paid attention to aligning market demand with technological capability. We had to look at technology and the market simultaneously. The biotechnology of agricultural products has upgraded quickly. Any delay in launching new seed products may lead to obsolescence. Rapidly introducing new seeds to the marketplace is important so as to create business opportunities. (Former Vice President)

The founder of Win-all can be regarded as an entrepreneur and innovator. Mr Zhang believes that "China is a large agricultural country, the seed industry is a cornerstone in agriculture" and he actively pursues his goal. With high opportunity-recognition, he led his team to turn his idea into a reality. The company's business strategy was very clear. The initial goal designed for Win-all was to start with R&D development and then prepare to go public to ensure further growth. This goal demanded significant innovation.

> The senior managers in our company are the oldest employees, most of whom once worked in state-owned seed enterprises. Because we suffered from deficient incentive structures in the state-owned company, we gave up our previous jobs to join Win-all and achieve personal development. We expected a bright future for our company. In the early period, we sold non-patented seeds to make a profit just to survive. The sales relied on the social networks and personal reputations of the two founders. At that time, the business operations of other small seed companies were quite similar to ours, but we moved faster than them. Developing our own

> products was the most urgent task. We didn't have a complex organisation, just 20 people working in one big office room. The situation was very difficult at that time. We were working so hard, no Sundays or other holidays. (Administration Director)

At the beginning of the company's establishment, Win-all had less than 20 employees. Most of them originally came from a state-owned firm (Fengle Seed Company) and had followed its former leader, Mr Zhang. With a commitment to the same goals, those 20 initial people pitched in and worked as the key management team. They are also the original shareholders of Win-all. This group of experienced people with a diversity of skills became a highly cohesive team targeted mainly at R&D and the marketing of new hybrid rice seeds. They were full of vigour and passion, supported and trusted each other, working well together for the achievement of the company's strategic objective.

> To establish Win-all, we put our own savings into the company. At that time, we had a great deal of solidarity, sharing the same beliefs and working very hard. Just looking back and reviewing our company's history, we never thought our company could grow so rapidly; it is beyond our wildest expectations. Our leaders let us make our dreams come true. (Vice Manager)

Win-all had a simple organisational structure with a single-headed leadership. The less organisational hierarchy and entrepreneurial flair contributed to Win-all's innovation. In the inception phase, the spirit of Mr Zhang was the core of its business culture. Mr Zhang was good at gauging people and put the right talents in the appropriate positions; he knew how to inspire people and carry through his own ideas, but also remained open to suggestions and objections. The corporate culture could be characterised as a family, and the management style was flexible and informal. This led to efficient, effective and rapid responses to the many changes in the industry. During the early stages of venture development, the entrepreneur's previous network contacts were important resources for marketing and branding.

Research-intensive innovation

"Put R&D first" is a fundamental strategy of Win-all. The leader and his management team know very well that independent innovation is vital for survival in the seed industry. In the initial phase, their objective was

to possess their own hybrid rice varieties. From the very beginning, they started to develop their own seeds by matching new technological possibilities with potential market needs. Win-all always analysed the available market information and focused on doing better in developing new technologies.

> The seed industry is characterised by high technical complexity, high development costs and short product life cycles. The seed product life cycle is generally comprised of five stages, including the area test and validation period, demonstration and introduction, growth, maturity and decline. The tendency of seed product life cycle is to become shorter and shorter. (Vice Manager)

R&D breeding in genetically modified crops takes a long time and involves tremendous technological uncertainty. The high trait rice species take six to eight generations until cultivation. It normally starts from elite parental lines, chosen from among the numerous genetic bases of possible parent materials for hybrid breeding work. A super variety depends on the quantity and quality of germplasm. Carrying out germplasm innovation and fostering a good parent gene in breeding plays an important role. The rice heterosis breeding of germplasm seeking, collecting, screening, identifying and improving is a complex process. And the experimental breeding of a new variety does not mean it will necessarily be available for production or the market. A good hybrid rice seed should be suitable for large-scale production with broad climate adaptability. Commercialising new rice varieties for the market is another complex procedure, which consists of appraisal, experimental plot testing, regional testing and the acquisition of national or provincial validity certificates. Therefore, the path from R&D breeding of new species to the market often takes as much as ten years.

> R&D is at a central place in the company. With so many years in this field, the basic science is well understood; one thing that is important is how we can continue conducting applied research and development work. We always placed great emphasis on R&D. The biggest problem is technological risk and market uncertainty; how do we deal with it? We keep a certain amount of R&D input every year, despite investment on R&D that requires long-term return. Although our R&D expenses are below some of the largest international seed companies, our investment is considered moderate. Technology and market opportunities may arise from constant R&D investment. (Technology Director)

Hybrid rice seed is cultivated from parental lines. In order to speed up R&D on breeding new hybrid varieties, Win-all built two laboratories, one in Anhui near the company's headquarter and another one in Sanya, Hainan, a tropical island in the south of China. The Sanya location was chosen mainly to use favourable local climate conditions for the experimental breeding of two sterile parent seeds. The company observed tendencies in market demand alongside technological feasibility. It utilised external resources and allocated internal resources for new product R&D. Their R&D made efforts to discover the agronomic traits of new varieties in order to bring the better varieties into the market. The laboratory experiment used cross-breeding methods incorporated with bio-technology engineering, utilising the heterosis of intersubspecific hybrids. This difficult work was taken up meticulously by the R&D team. Mr Cheng was an R&D manager who conducted the experimental research. Prior to coming to Win-all, he was a senior researcher at Fengle Seed Company. His previous technology experience allowed his R&D team to shorten time frames for new seed development; their R&D capability did not start from zero. After technological consultation with an expert panel consisting of six senior agronomical scientists from Anhui Agricultural Academy of Science, as well as thousands of rigorous experiments over three years, his R&D team ultimately found an important male-sterile that was suitable for the creation of high-yield rice species. Based on this male species, the team successfully cultivated a type of hybrid rice species with great advantages, called "Two Excellent New 6". It is the one of the most fruitful rice species, exhibiting a set of salient traits such as high growth rates, high yield, multiple resistances and wide adaptability. The period of R&D was notably shorter compared to other seed firms. In 2005, Win-all introduced this new seed to farmers, and soon spread to the whole Chinese seed market. Win-all deployed its internal strengths and available external resources to achieve the first breakthrough product during the first years of its existence.

> The new product R&D combined our accumulated technical strengths with market needs. The first seed product that we launched achieved huge success; our revenue increased significantly in the succeeding years. It became one of the best-selling hybrid seeds in the market. We have always placed great emphasis on product and technological innovation. We remain on the frontier of the emerging field of seed science. In past

> years, many new hybrid rice varieties have been introduced to market, such as "Two Excellent New 106", "Two Excellent New 343", "New Two Excellent 901" and "Xinhua S/YR293" were gradually from laboratory to the market. The "Two Excellent 343" is becoming the main new seed on the market. (Technology Director)

Because China has leading technological advantages in hybrid rice, Win-all's product innovation can be considered as "new to the world". Due to this sort of ground-breaking technological innovation, Win-all has achieved great success and the company entered the fast track of development. 2005 to 2009 were its years of fastest growth, where the company's performance regularly exceeded its previous goals. Win-all has now brought several important seeds to market, and has received numerous awards for its technological innovations. Win-all's R&D expenditure was 3.69 million RMB in 2007, 3.41 million RMB in 2008, 6.38 million RMB in 2009, 8.90 RMB million in 2010 and 13.1 RMB million in 2011, or around 4.21%, 2.79%, 3.89%, 4.94% and 4.70% of each year's turnover, respectively. Technological innovation at Win-all lays the foundation for market expansion.

> In order to stay competitive, we need to introduce new seed products to the market in a timely way. A high-tech company must update its technology constantly. Besides our research staff, we need professional advice from external experts and scientists to shorten the time required for R&D. We keep in contact with best-in-class scientists. They may even have some good new seed varieties on hand that we can use without delay. Meanwhile, we have proposed research directions for future development, emphasising more links to the market. (Technology Director)

The technical staff are regarded as the company's core competitive strength. The R&D department now has more than 30 employees, or 34% of the total workforce, and eight hold master's degrees. The company focuses on keeping technical talent, as the R&D personnel are given the highest salary. In fact, although Win-all has spent much time strengthening its new plant variety rights and asserting intellectual property protection, it still has a large amount of high-end technology and know-how that is not protected. Win-all has therefore signed a "trade secret confidentiality agreement" between all the technical employees and some relevant management personnel. In order to retain professional employees, Win-all also insists on a "people first" strategy

by establishing mutual benefits for the company and its employees, such as key technical employees holding equity in the firm. The company gives many kinds of rewards to its R&D staff, including specific project rewards, dedication rewards and breakthrough rewards. The incentive schemes are designed to motivate and retain its R&D talents.

Marketing-networking innovation

Normally, seed demand is roughly stable in China every year. Win-all has to compete with large domestic seed companies and foreign multinationals in China. In order to increase sales and profits, Win-all has to keep its existing market and wrest the market share away from its competitors. Win-all differs from other small seed firms in its high-end scientific knowledge and the market demand for its products. In the seed industry, high-quality seed with good agronomic traits and customer service differentiation are the two critical factors to determining a seed firm's success in the market. Based on fully understanding the situation in China's agricultural sector, Win-all formulated a "breeding, producing and marketing" integrative business model by using different actors to expedite the commercialisation of their hybrid seeds.

The company's reputation has been promoted through small scale multi-plot trial shows, on-site demonstration meetings and TV media advertising in the main rice-growing areas. Farmers became more interested in Win-all's seeds after seeing the results of frontline demonstrations. With a good product combined with market promotions, Win-all has gradually obtained recognition for its brand and products.

> Unlike other sectors, the seed industry is a high-tech and knowledge-based industry. Technological innovation is vital, but a company's strategy and business model are also important as well. In some sense, scientific abilities must be combined with business management abilities. In order to realise efficient market promotion, we established a "Company + Dealers + Agricultural Extension Agency" cooperative commercial model for delivering and marketing. To strengthen our market power, we built a marketing centre in Hubei in 2011. (Sales Manager)

Through a combination of the local Agriculture Technology Extension Service Agencies and seed distributors, Win-all has established an innovative commercial network that involves multiple actors in the

entire marketing, promoting and service process. By effectively integrating the marketing resources of external dealers and agricultural technology service departments, Win-all has achieved great commercial success. Their sales network covers more than 16 provinces in China. Multiple parties are involved in the industrial chain, from planting to production processing, from distribution channel to services, etc. Win-all has built up a multi-win-win platform that links up with the participation of the agricultural technology extension agencies and the seed dealers, who together have become a seed supply network in the "company + dealers + agricultural extension departments" model. The collaboration is based on long-term, stable, mutually beneficial and cooperative relationships, and enables Win-all to improve its strategic position, focus on its core business, expend markets and reduce transaction costs. The local agriculture extension agencies are responsible for technology transfer services, providing technical guidance to farmers during the critical period of seed sowing, flowering, pollinating, growing, and an after-sales service system. Local dealers can deliver seeds to nearby farmers. The commercial networks have proven to be a convenient seed supply chain. This sort of marketing alliance and service network has the specific merit of helping farmers increase their production; in return, it has attracted more farmers to choose Win-all's seeds. This model leads to new commercial developments. It has also opened a valuable communication channel between farmers and researchers. The market information feedback through the networks of dealers assists the company to understand more fully the tendencies of market demand. Win-all has gradually established a set of stable markets in the main rice-production areas in China.

> We place special attention on university-industry research cooperation. Our research network spans widely across China, consisting of two universities and three academic research institutes. These are long-term collaborations based on trust. We also have many joint research projects on the basis of our contacts. We signed a cooperative agreement with Anhui Aquiculture Academy of science to co-found a molecular breeding laboratory. (Technology Director)

Win-all uses external resources to enhance its technological capability. The management team has relationships with many different kinds of organisations, such as local Anhui governments and research

institutions, agricultural sectors and seed distribution channels. Furthermore, Win-all works closely with a network of universities and scientific research institutes for product development purposes. There are several formal collaborative arrangements between Win-all and universities; for example, Win-all has formed a strategic partnership with Anhui Agriculture University and the Guangdong Academy of Agricultural Sciences. By establishing collaborative relationships or co-research projects, Win-all benefits from the scientific expertise of others.

By keeping up good trade relations and cooperation with foreign customers, Win-all is actively expanding into international markets. Since 2006, its hybrid rice has been exported to Bangladesh, Pakistan, Indonesia and other Southeast Asian countries. In 2009, its total export of hybrid rice was over 860 million kg. The Win-all brand has gained a reputation of some significance in South Asia.

Risk-related innovation

Hybrid rice seed production technology is considered knowledge-intensive and requires high R&D investment. It involves various risks and uncertainty, especially in the early stages when seed producers still lack technology and operational experience. As a small seed company, Win-all is able to evaluate and react to risk systematically in order to lower the risk of innovation actions.

Win-all outsources seed production to lower its breeding risks. They outsource their seed production to private seed companies, who sell directly to the farmers for planting. The plan for seed production in each year follows the previous year's seed sales and the prediction of next year's market demand. Agricultural production has significant seasonal characteristics.

> Our main products are two-line hybrid rice varieties. The quality of two-line hybrid rice seed is sensitive to the temperature and weather, so we created the breeding technology of "natural low temperature stress to plant selection" and the "original seed crop of long-term cold storage or continuous regeneration cutting" technology. These approaches can maintain the original seed fertility and the stability of the original species. Furthermore, hybrid seed production is also greatly affected by natural disasters or other climatic factors. In order to minimise the impact of these various factors on seed quality, we carefully select fields around China to ensure that the local climate fits the seeds in that area. (Production Manager)

To minimise seed production risks, quality control is carried out throughout the entire process. This includes the nucleus, breeder, foundation and certified seed production of both parental lines and the first-generation hybrid. In order to produce high-quality rice seeds, Win-all expanded its seed production to different eco-regional areas, with seed production bases are various from the south to the north of China. In total, Win-all has built ten stable hybrid rice seed production bases in Hainan, Guangdong, Guangxi, Sichuan, Guizhou, Fujian, Jiangxi, Anhui, Jiangsu and other regions. Nationwide dispersion greatly reduces seed production risks. Win-all has researched the highest national standards of germination rate, purity, clarity, moisture, etc. Its seed quality is at the forefront of China's seed industry.

To avoid technology replication risks, Win-all stresses the use of copyrights, trademarks and other intellectual property control measures to guard itself against copycats and imitators. They use intellectual property rights actively to keep their new products and technology proprietary.

The process of a seed from laboratory to market, including research, development, approval and commercialisation to market launch, takes at least five years. That period requires a great deal of capital, technology and human input with great uncertainty. Sometimes, significant financial and time investments may be fruitless. In fact, many SMEs lack the financial resources for R&D. Win-all also faced a real challenge in obtaining external financial capital. Relying purely on organic growth and self-accumulated finance to support R&D expenditure is not always sufficient. Financial resources were essential to continue the firm's rapid growth. At the earlier stage of company, in 2004 the previous CEO Mr Zhang had already looked for financing outside the company. A couple of years before establishing Win-all, he had helped the Fengle Seed Company to access the public market when he was a director in this state-owned seed enterprise. Accessing external financial resources was considered the best way to minimise risks and leverage a firm's performance.

> We focus on action and execution, rather than waiting. Differing from other small seed firms, we grasped a lot of opportunities. I would like to use the old Chinese saying to summarise it. The success of our company is attributed to three vital elements: "tainshi" is a heavenly force, it means good timing and favourable climate, "dili" means favourable geographical

> condition or good positions, and "renhe" means human capital and relations. These are favourable objective and subjective factors for success. Win-all was perfect at combining these factors at the right time and in the right place. After being listed on the stock market, sufficient financial resources allowed our company to maintain the innovation activities in R&D as well as growth. Our success is not a coincidence or serendipity. Remember that good fortune favours those who are prepared. Win-all is such a case. (Former President)

In October 2009, the Growth Enterprise Market board was launched for SMEs in the Shenzhen Stock Exchange Market. The GEB was officially opened to fast-growing SMEs with outstanding performance or technology and innovation-oriented start-ups. On the basis of three consecutive years of hyper-growth and its early success, Win-all became one of the fastest growing small enterprises in China and was ready to be transformed into a public enterprise. The critical point of development was based on anticipating and taking the opportunity at precisely the right moment. Mr Zhang shepherded his decisive strategic action once again, this time to push Win-all into the public capital market. The purpose of accessing capital market was not merely to spread out the R&D risks, but also to enhance the pace of the company's growth. Win-all grasped a perfect opportunity to be listed on the Stock Exchange Market in 2010. Win-all accessed the right kind of finance at the right time, gaining a better chance at long-term prosperity. It was a crucial step in the company success. In the following years, Win-all implemented a horizontal diversification strategy, gaining technology and market share through the acquisition and merger of other enterprises. They acquired seven other seed companies to strengthen their product portfolio and realised horizontal diversification. Their business scope extended from hybrid seeds to other kind of crop seeds.

Summary and Implications

In only a decade, Win-all developed from small to large, from weak to strong, from a little-known small company to a well-known diversified seed enterprise. As an effective high-growth enterprise, Win-all had a structured approach to improving its innovation capabilities at different stages of development. They have deployed proper innovative strategies to meet China's emerging seed market in the best possible ways. Win-all is a good example of an innovation-driven firm. Their innovation

strategy matched the industry's development even better than its competitors. Innovation can make a firm to take a giant leap into the market competition. Win-all was particularly innovative from three perspectives: moving from path-breaking product innovation to an integrative innovation pattern and finally to a high degree of horizontal diversification. Different small firms appear to generate alternative innovation paths, based on their resources, skills, past experiences and particular capabilities. Win-all used strategic innovation to gain the technology and resources to extend their capabilities, realising dramatic development in the long run. Innovation is a shortcut to achieving this goal. At present, Win-all is entering a new stage of development. The company retains its leading position in China's emerging seed market.

Technological innovation is the essence of overall innovation in high-tech SMEs. As a science-intensive firm, Win-all exhibits high levels of innovation capability. Win-all set the highest priority for its technological innovation and invested a great deal of resources into technological capability to achieve R&D breakthroughs in a relatively short period of time. Win-all differs from other small seed firms, because it synthesised scientific knowledge with market demand appropriately. The results indicate that small high-tech firms cannot be successful without technological advantages, and that technology should also match market needs. High-tech firms that aim to become leaders in their industries must differentiate themselves on the basis of outstanding technological capability that is built on their unique knowledge and resources.

Additionally, Win-all has higher R&D productivity than its competitors due to its strong links with academic research institutions, which shortens research time and offers access to scientific and technical opportunities. The company's technological development benefits through industry-university research cooperation and the integration of external sources of know-how into their internal R&D efforts. By focusing its limited resources on new product development and involvement with research institutions, its R&D people have taken much less time to succeed in core technology exploration. The Win-all case illustrates that collaboration with academic research organisations can enhance an SME's R&D capability.

Meanwhile, the founder's strategic decision in the initial years has proved crucial for the success of the new venture. With regard to knowledge-intensive products, Win-all started to compete not only with a technological advantage, but also on the basis of its ability to provide products by building up commercial networks. A firm must be able to adopt the necessary innovations at the right time to achieve success in the marketplace. The need to answer a timely opportunity properly is clearly reflected in the Win-all case. Win-all successfully aligned innovation strategies with development objectives. When China reformed the agriculture sector and the Chinese Seed Law opened the possibility of SMEs engaging in this market, Win-all was a first mover initiated business in the emerging market at just the right time. When the Chinese government encouraged highly innovative firms to raise funds from the stock market, Win-all again demonstrated its ability to access the right kind of finance at the right time. Not every small firm has the ability to respond to opportunities for growth. In summary, its internal strategy-related capabilities played a major role in accelerating innovation and determining innovation success. External factors make innovation necessary; such as economic growth, technological changes and government policy support that create many opportunities for SMEs. These firms must learn how to seize those opportunities to development. Finally, through networking, an SME can tap into external sources of knowledge, ideas and resources to gain innovation capability.

Table 10. Win-all company analysis

Type of technology in the case company	Sub-category	Theme	Key points in empirical data
Knowledge-intensive technology	**Research-intensive innovation**	A clear R&D strategic plan; science-based and high-tech direction, strong R&D efforts, the combination of technological possibility with market demands	- R&D-first policy, emphasis on R&D, diverting limited resources to new product development - Broad cooperation with academic and science institutes and specific universities, providing funding for specific R&D projects - Keeping up-to-date with technological advances, strong research and knowledge intensity to support NPD
	Market-networking innovation	Diverse sources and external actors in the innovative commercialisation model	- Novel marketing model of "Company + dealers + agricultural extension departments" - Involved in the agricultural technology extension sectors and seed dealers - Exploring international markets in South Asia
	Risk-related innovation	Evaluating risk and finding solutions to avoid technological risk and market uncertainty	- Listed on the stock market, accessing external finance sources - Widely outsourcing seed production - Using IPR and the new variety licenses to protect advanced technology

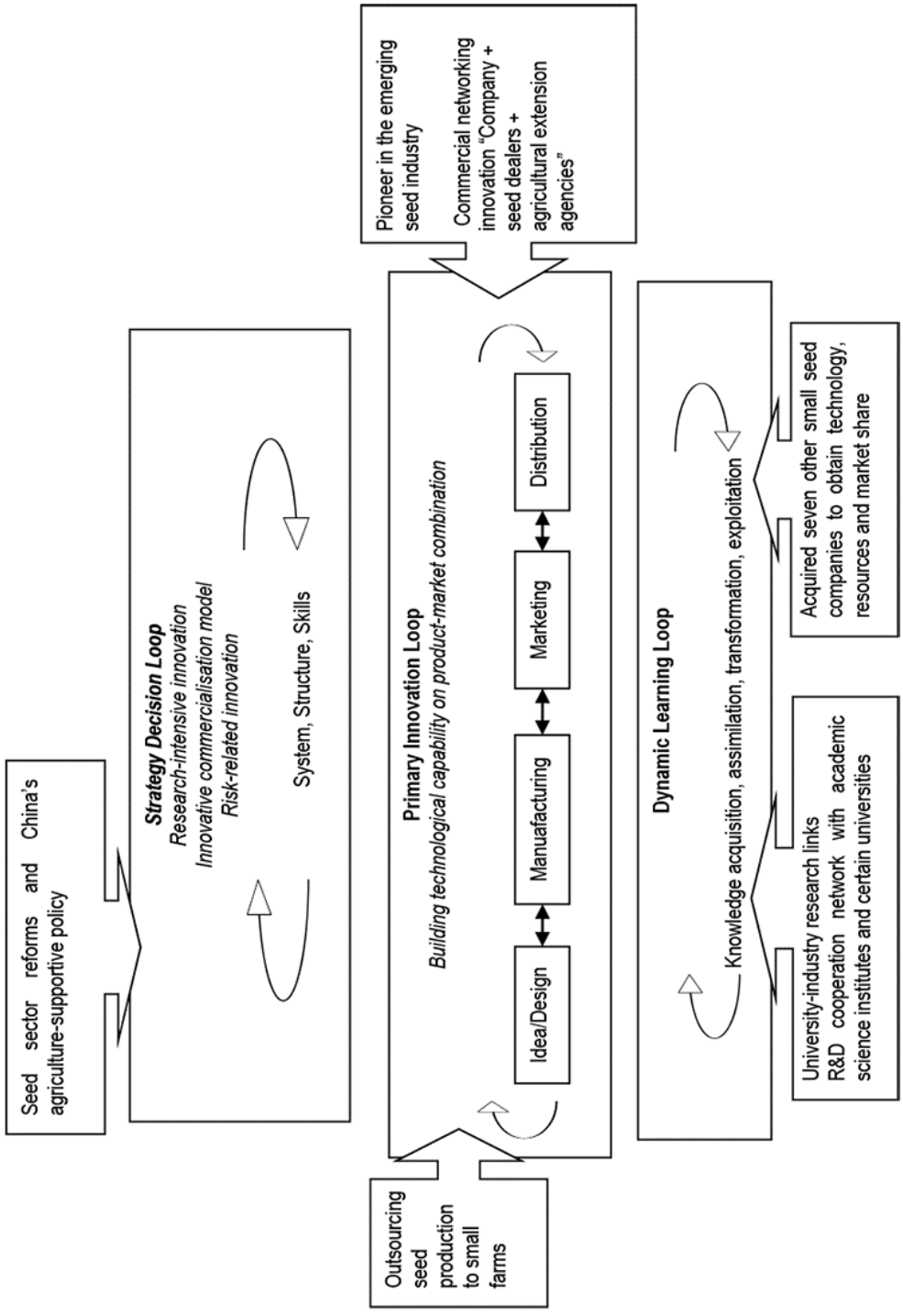

Figure 15. Win-all Company Analysis

6 MULTIPLE CROSS-CASE ANALYSIS AND DISCUSSION

This dissertation sheds light on innovative activities within the context of small and medium-sized businesses, focusing particularly on Chinese small and medium-sized firms. This focus allows me to draw detailed conclusions for this specific context. Several implications for SME innovation research and practice can be derived from this study. In this chapter, I discuss the findings from a cross-case comparison analysis of five cases and answer the research questions given in Chapter 1.

The main research question set for the study is: how do SMEs innovate in the Chinese context? The three sub-questions were formulated as follows:

RQ1: What are the motivations and drivers for SMEs to innovate?

RQ2: What kind of innovations have they developed in practice?

RQ3: How have they carried out the processes related to these innovations?

6.1 Cross-case analysis

6.1.1 Motivations and drivers for SMEs to innovate

What are the driving forces behind Chinese SME innovation? This study suggests that Chinese SME innovations are both internally and externally driven. China's dynamic competitive business environment and entrepreneurs are the key impetuses that spur Chinese SMEs to innovate.

External driving force: Emerging economic factors are an important driving force for Chinese SMEs to embrace innovation. Since China embarked on reforms and opening its doors to the world in 1978,

the political, economic, institutional and social environment in the country has changed dramatically. Unsurprisingly, Chinese SME innovation was triggered by enormous potential markets and consequent opportunities. Going from a centrally planned economy to a market-oriented economy in three decades, China's transition economy has brought tremendous business opportunities for Chinese SMEs. Many industries opened to non-public enterprises that favoured greater entrepreneurial ventures. Chinese SMEs have undergone massive changes over the past several years. From the political aspect, China has issued and amended a series of laws to reform its legal infrastructure and to build healthy, regulated market competition (Li & Zhang, 2007; Tan & Tan, 2005), which fertilizes a more favourable and supportive environment for SME innovation and entrepreneurship. Meanwhile, many local governments have also established funds to reward innovation-related activities in their regions (Tang & Tang, 2010). Between 1999 and 2013, China spent a total of 26.8 billion yuan ($4.4 billion) to support innovation by small- and medium-sized enterprises.[12] From the perspective of social structure, private property and various ownership structures are now encouraged. Entrepreneurship has been accepted and even celebrated by Chinese society. Privatisation has provided a vast platform for the development of SMEs. From the economic perspective, China has become one of the largest and fastest growing economies in the world. According to the newest IMF report, China has just overtaken the United States as the world's largest economy on a purchasing power parity basis.[13] Economic growth and the large scale of internal consumer demand stimulate more entrepreneurial behaviours and SME development. From the market perspective, China joined the World Trade Organisation (WTO) in 2001, which has given Chinese SMEs opportunities to access international markets. From the technological perspective, the new information era and intensive, ongoing technological upgrading create further possibilities for Chinese SMEs.

From the case firm viewpoint, China's rapid economic development, institutional transition, technological changes and domestic market boom have created great opportunities. They have benefited from these

[12] http://www.chinadaily.com.cn/bizchina/2013-10/26/content_17060358.htm

[13] http://www.businessinsider.com.au/china-overtakes-us-as-worlds-largest-economy-2014-10

changes and have grown rapidly, and in some cases at a breath-taking pace. The general fast-changing environment in China drives the growth of Chinese SMEs and stimulates them to innovation. In such macro-economic conditions, SMEs have greater motivation to commit to innovation.

According to Chen (2006), China's SMEs are at the third phase of development. The unprecedented growth of SMEs reflects a unique feature of the political, institutional, social and economic reforms in China (Cunningham, 2011). Furthermore, China's transitional economy is characterised by high turbulence that is far greater than in developed countries. In China, the birth and death rates of enterprises are both high. Small Chinese firms encounter the challenge of fierce competition, so they have to develop distinctive strategic competences (Li, Zhao, Tan & Liu, 2008). With continued movement towards a market economy, market competition mechanisms push Chinese SMEs to accelerate innovations. China's economic construction is complex and uncertain, and transforming to a free market will take a long time (Luo & Park, 2001). Especially at present, with China's high economic growth slowing down, SMEs are under pressure to search for new opportunities and innovation strategies to survive. In sum, SMEs operating in a turbulent and fast-changing environment are likely to be more innovative in order to response to intense competition.

The Chinese government promulgated a nationwide 2006–2020 science and technology development plan in 2006,[14] and a new five-year national independent innovation capability construction plan in 2013.[15] China's new national development strategy stresses indigenous innovation and aims to promote sustainable development in all aspects of the economy and society. China's goal is to evolve from a low-cost, low-wage labour economy into a high-tech, innovation-oriented country by 2020. This new reform policy urges SMEs to change their competition models, moving to higher levels of innovation for sustainable competitiveness in global markets. These fast-growing markets provide powerful incentives for SME to innovate. Chinese SMEs thus have to learn to be more innovative in order to cope with increasing global and domestic competition. To sum up, China's dynamic and emerging

[14] http://www.gov.cn/jrzg/2006-02/09/content_183787.htm

[15] http://www.gov.cn/zwgk/2013-05/29/content_2414100.htm

economy remains an impetus for Chinese SMEs to innovate. It spurs Chinese SMEs towards increased R&D and industrialisation, accelerating the pace of innovation.

Internal driving force: Firm-level entrepreneurship is the internal force that drives SME innovation. In China, most SMEs are entrepreneurial ventures. Many owners of small firms are also founder-entrepreneurs. They serve as the chief executives of their enterprises and therefore have a greater incentive to innovate; they "start small, but think big". In fact, most SMEs in China started from very small entrepreneurial ventures. Unlike opportunity-driven motivation, owner-managers in the sample firms are dynamic, entrepreneurial and have a long-term commitment. They do not look just at short-term opportunities. Owner-managers act as entrepreneurs in the organisation, shape business activity and aim for sustained development. The founders of enterprises did not start their businesses by accident; instead, they were not satisfied with the status quo and so started their own business for a sense of personal achievement. Many have significant work experience and a clear business idea in mind. Normally, entrepreneurship can mean one person or several people interacting in an entrepreneurial team, such as in the Win-all company. Based on the case analysis, I argue that entrepreneurs or top managers can be identified as vital contributors to the success of innovation in their enterprises. Their dynamic, entrepreneurial, long-term oriented leadership style favours their innovative actions.

The personality traits of CEO-entrepreneurs affect the strategic direction of their firms (Peterson et al., 2003; Judge, Piccolo, & Kosalka, 2009). It seems that the entrepreneurial spirit is spreading widely throughout Chinese firms. Owner-managers have strong ambitions, passion, and personal experience and are closely involved in innovation activities. The passion of entrepreneurs steers innovation, and more innovative SMEs also tend to be growth-oriented. Entrepreneurs bring their aspirations to the organisation. Consider some of these quotations: "I grow my company like raising a child; I regard it as my entire life's career"; "I view my company as my home and my employees as my family"; "To build an enterprise takes more than a hundred years". These mottos reflect the owner-managers' entrepreneurial ambitions. They are

enthusiastic about innovation that leads their enterprises to engage in innovation-related actions. Without persistence, confidence, enthusiasm and diligence, they could not achieve such success.

Innovation occurs as entrepreneurs perceive and exploit emerging opportunities. It can be argued that Chinese entrepreneurs demonstrate their competence in the creation, recognition and utilisation of opportunities, benefiting from China's transitional environment. In those cases, owner-managers search out and analyse business information appropriately, trying to take advantage of suitable opportunities. With familiarity with their local markets and by paying attention to the Chinese government's policy changes, they can not only find high-growth markets, but also subsequently set themselves up in business to turn mere potential into a profitable new venture. They often identify business opportunities for their individual purposes and are willing to trust their own judgment. With a long-term development orientation and well-informed viewpoint, they make decisions in relation to future market possibilities and respond promptly to promising opportunities.

The interviewees mentioned that "the strategic decision is made mostly by the boss". The owner-manager is thus of great significance in leading innovation actions in SMEs. Almost all the innovation decisions in organisations are made by entrepreneurs in China. In small Chinese firms, entrepreneurs are the pivotal decision makers in determining innovation strategies. SMEs and their leaders can employ proper strategies to meet the requirements of China's dynamic, emerging economy (Tang & Tang, 2010). In most cases, the innovation in firms undertaking innovative activities is initiated and directed by its owner-managers. Owner-managers determine the selection, building and nurturing of innovation activities. They are responsible for the exploitation of fundamental innovation as both idea generators and executors that shape ideas into business plans

Entrepreneurs have the characteristics of an innovative mind-set, higher motivation to achieve and a greater taste for taking risks, all of which are particularly important for SME innovation. The case firms demonstrate a strong entrepreneurial orientation. Entrepreneurial orientation has a positive relationship to the ability of a firm to be innovative. Innovation activities are empowered by the entrepreneur,

who favours proactive decision-taking. The case firms display a high degree of entrepreneurial outlook and influence in their innovation decision-making processes. Owner-managers encourage the rapid growth of their companies, and are thus of importance in conducting innovation activities.

CEOs, the perceptions top entrepreneurs have of innovation and the background and role of entrepreneurs are all critical in SME innovation (Krishnaswamy, Subrahmanya & Mathirajan, 2010). As we saw with the case-study firms, innovation in Chinese SMEs depends on an entrepreneur's personal ability and experience. Entrepreneurs accumulated technological or managerial knowledge before starting their own businesses. The case-study entrepreneurs mostly started their business in the same industry in which they had gained previous work experience. That industry experience gives an entrepreneur crucial knowledge and business contacts to help them launch a new venture (Zhang, Yang, & Ma, 2008). This study has discovered that entrepreneurs with previous work experience or professional backgrounds are able to contribute creative solutions to an organisation. Previous work experience obtained by entrepreneurs can also have a significant impact on their marketing analysis and decision-making. The more prior work experience that entrepreneurs have in a given field, the more they are likely to identify potential opportunities.

This result is consistent with earlier studies which show that the previously acquired knowledge and experience of small business owners conditions their managerial behaviour (Thong, 1999). Entrepreneurs with many years of work experience usually see faster growth in their businesses, particularly if their experiences were related to the same sector (Nichter & Goldmark, 2009). In the cases in this study, most owner-managers had previous work experience in the same industry, prior knowledge of products and customers, and particularly information about the market. Many owner-managers are engineers or scientists who are responsible for, or are personally part of, the innovation project team. For instance, the president of Xiwo and CEO of Leo, the former vice president and current executive vice presidents of Win-all have academic or technical backgrounds and play active roles in the research team. An owner-manager with an academic background and relevant managerial experience can boost a firm's innovation capability. Beyond

obtaining business and managerial knowledge through learning-by-doing, Chinese SME managers have engaged in fast learning from a variety of sources (Mu, Peng, & Tan, 2007). Higher education is a source that can provide an entrepreneur with necessary skills. The presidents of Changjiang and Xiwo attended MBA education courses in universities and exploited their educations in their business practices.

To sum up, Chinese SMEs display an entrepreneurial orientation in their innovation processes. According to the analysis, entrepreneurs are willing to carry out innovations on calculated risks for investment returns or superior profits. They generally have an open attitude towards innovation and change, thinking deeply about new business opportunities even if they do not wade into the details of technical innovation. They are more inclined to engage in strategic innovations and have stronger aspirations for capturing emerging opportunities in the external environment and developing innovative capabilities. They understand their businesses and their environments, actively seizing opportunities through innovation. It could be argued that entrepreneurial orientation is more critical for successful SME innovation in transition and developing economies than in the developed world. SMEs are facing rapidly changing demands, so there has to be a greater entrepreneurial orientation in order to retain a competitive position in the marketplace. Entrepreneurial decision-making can be regarded as an efficient method for coping with a complex and fast-changing environment.

6.1.2 Innovation strategies and patterns

Innovation in SMEs should be viewed as dynamic and interactive processes relating to a variety of elements and network links. The following cross-case analysis is based on the generic innovation model proposed in Chapter 3. The case firms organise and manage innovation, following three processes, as presented in Table 11.

Table 11. Cross-case analysis

Cases	Strategy process	Primary innovation process	Learning process	External actors
Huize	**Strategy**: an appropriate company position strategy, specialising in their main business with a particular technology and market target **Structure**: flat structure and lack of bureaucracy **Skills**: depth of specified technological skills, direct hire of experienced technical personnel	• total quality management • the use of advanced components and reliable materials in the product • committed to continual cutting-edge product improvement	buy-in patented technology integrated with self-exploited knowledge	suppliers retailers associations
Changjiang	**Strategy**: actively pursues changes and adoptions, searching for new innovations **Structure**: integrated activity that involves innovative organisational climate over the whole organisation **Skill**: empower employees to be involved innovation process	• offering total solutions rather than selling single products • cross-functional teamwork to act in marketing and overall services • all-involvement innovation activity in lean management	investment in knowledge building, facilitating tacit knowledge flows inside the company and procuring knowledge from outside	suppliers customers universities consulting firms
Xiwo	**Strategy**: adaptive strategy, developing with large firms **Structure**: a strong middle management team participating in the innovation process **Skill**: invest in the training of middle managers	• extending product design and upgrading processes • using new tools and techniques for cost reduction and maximum productivity • implementing 6S to enhance manufacturing process	accumulated knowledge through learning by doing, learning by interaction with large customers, training key managers	customers universities associations

Cases	Strategy process	Primary innovation process	Learning process	External actors
Leo	**Strategy**: redefine development direction and innovation strategy **Structure**: ownership changes and organisation restructure **Skills**: CEO,CTO and key R&D engineers come from the parent organisation	• creating additional value for existing products • exploit new business by application of existing technology • reconfiguration of technologies and markets for new business	assimilating advanced knowledge from the parent organisation, transforming basic research into applied technology	customer-partners parent research institute government
Win-all	**Strategy**: Clear company goals for product innovation, keep technology capability at the leading edge of the technology frontier **Structure**: constantly adjusted and improved organisational structure over time **Skill**: retain key scientific staff	• marketing–R&D integration, technology and product innovation link to market requirements	obtaining knowledge and resources from mergers and acquisitions. Knowledge flow between critical scientists and research institutions	universities research organisations distributors other partners

Internal process of SME innovation and factors involved

1. Strategy process

Strategy: The case-study enterprises have clear goals and well-defined strategies regarding innovation. They pursue strategies that seem to fit their unique resources and particular circumstances. They formulate certain innovative strategies according to their own market positions, resources and experiences. Principally SMEs need an innovative strategy, particularly in today's highly competitive environment. An innovative strategy is crucial for the survival and growth of SMEs in the long term. The direction of innovation is guided by a clear vision, and innovative strategy tends to be crafted in an adoptive way. It can be argued that the case-study enterprises carry out innovative strategies to meet the requirements of China's dynamic, emerging economy and also encompass firm-specific features, such as resources and capabilities. By carefully shaping their innovation-related objectives, those firms usually have a longer-term strategic focus. At Win-all, innovation is the core of the company's overall strategy as an important part of their daily work. Leo Company redefined its development direction and innovation strategy, successful entering into new markets by providing new services. Changjiang is actively pursuing changes, searching for new innovative strategies at different stages of development. Huize's strategy is to focus its main business on a particular technology and target market that has retained a lasting niche advantage over competitors.

Structure: The structure is the form of an organisation so as to manage innovation processes and implement innovation projects. SMEs should build a supportive platform for new idea creation, effective communication and information exchange within the organisation. The case-study companies generally seem to possess fairly low organisational hierarchy and good internal communications. The organisational setting is flexible for creativity, teamwork and interaction. Structural adjustment and upgrades should be flexible to enable prompt replies to market changes. Start-ups or early-stage entrepreneurial SMEs that operate with a less formal structure can be capable of rapid responses to market opportunities. SMEs may develop more formal planning or structures as

the company grows in size. The prerequisite is to keep innovative structures, the ability to adapt and to change quickly in a competitive environment (Bessant & Caffyn, 1997). Changjiang cultivates an innovative organisational climate that empowers employee participation in innovation activities. As with other new small enterprises, Huize has a flat organisational structure with low levels of bureaucracy. Changjiang promotes innovation involvement across all functional departments, using cross-functional teamwork to organise the innovation process, coordinating and cooperating in R&D, marketing, manufacturing and the call centre. Xiwo has established a strong management team that works together on innovative project development and implementation. Leo changed its previous ownership and revamped its rigid management structure, becoming more innovative in orientation. Win-all forges internal communications across department boundaries, building an innovation mission into organisational routines and procedures. It adjusted and improved its organisational structure as the company grew in size.

Skills: Skills are a company's technological ability and the expertise in specific areas which are not easily replicated or imitated by competitors. SMEs possess particular skills that reside largely in key individual employees, such as highly qualified technicians, engineers or scientists. Skilled labour is recognised as a significant intangible asset that has a direct effect on small innovative firms (Acs & Audretsch, 1988). Labour quality is a vital and dynamic element in the innovation process of SMEs. The case companies place great emphasis on employee development, investing in training to improve their workers' comprehensive skills. A high-quality workforce with specific knowledge can yield sustained competitive advantage. The case-study firms considered skilled employees and high-quality workforces to be crucial in the innovation process. Huize hired a technical specialist from overseas as an R&D director to conduct research experiments. Xiwo emphasises developing high-level workforce skills by investing in the training of middle managers and team leaders outside the company. Changjiang recruits new graduates from top universities and skilled workers every year, implementing reward mechanisms and internal promotion policies. The CEO, CTO and R&D engineers at Leo all come from the parent research

institute. Win-all retains key scientists at the company to maintain its strength in leading technologies.

2. Primary innovation process

The primary innovation process is fundamental and refers to a variety of different phases or stages of innovation development, usually running from idea generation to implementation, from R&D to commercially viable offerings.

The innovation process can be described as a value-adding process or a new value-creating process. From the multi-case analysis, we can see that the Huize company firmly grasps the most important scientific and technological innovations, based on high-end market demand to strengthen its R&D of high-tech and high value-added products. The Leo company creates additional value in existing products to satisfy customers and extend existing technology applications.

Innovations take place within and across the various functions of the firm, including product development, manufacturing, marketing, distribution and service. The integration of marketing, production and R&D development is essential in this process. Changjiang endeavours to develop new products, processes and services through interdepartmental connections, broadening its product portfolio from selling components or single products to delivering comprehensive solutions.

Technology development should respond to market trends, incorporating technological strength and commercial viability. Product-market combinations guide the developing of new products, extending a firm's product range, improving existing product quality and product flexibility, enhancing existing processes and product designs. R&D needs to integrate with market opportunities, understanding not only new market opportunities but also technological possibilities. The Win-all case demonstrates a high level of integration between marketing and R&D to support the creativity of new product, processes or services that match market requirements.

3. Learning process

Knowledge is a particularly important element in the innovation process (Thornhill, 2006). New knowledge arises from recurrent circles of learning; SMEs may attempt to gain knowledge or technology faster through buy-ins or mergers and acquisitions, such as Huize purchasing patents to acquire new technological knowledge quickly. The Win-all company extended its technology, resources and capabilities through the acquisition of other seed firms.

The learning process is concerned with knowledge exchange, and with expertise flowing into and out of a firm. The case-study firms demonstrate that they can gather, share and utilise knowledge derived from both inside and outside their companies. Changjiang not only generates knowledge internally by the training of employees, but also procures knowledge from outside the company. Some firms acquire knowledge based on past experiences. The Xiwo company accumulated sophisticated engineering technology and know-how through learning-by-doing and interacting with large customers. By building up an e-learning platform, Changjiang facilitates efficient knowledge flows within the company, increasing both individual learning and organisational learning.

The learning process can be made more efficient by networking, interacting and sharing knowledge with other companies. Changjiang acquires external technical knowledge via strategic alliances with leading foreign firms, and Xiwo obtains complementary knowledge by bringing large customers into its product design process, using customer knowledge to develop innovative products.

Innovation calls for a wide variety of fields of knowledge. Most new knowledge is generated by communication and interaction with external partners. Chinese SMEs have committed to rapid learning and technological catch-up, and benefit from production and technological cooperation with different enterprises or organisations. In the following section, the external interrelationships with multiple actors in innovation processes will be examined in more detail.

External linkages of SME innovation

Networking and relationships have always been considered extremely important in Chinese society as a whole. Innovation activity in Chinese SMEs occurs increasingly across organisations, involves related social networks, institutional links and supply chain partners in order to seek extended R&D funding, development, marketing and distribution. In this study, it was seen that many innovations were developed in collaboration between the case firms and other organisations. A diversity of actors in networks can be notably seen. SMEs obtain competitive sources and absorb knowledge from outside to build their own capabilities. The cross-case analysis indicates that SMEs utilise external networks so as to be more innovative.

Customer and supplier relationships

Customers and suppliers are vital actors in the innovation process, who often directly affect the results of the innovation of a new product, process or service. Close collaborative partnerships along the industrial value-chain are prevalent in the innovation process of the case-study SMEs. On the basis of supply chain cooperation, SMEs have been actively involved in the cross-fertilisation of innovation ideas with both suppliers and customers. Some case companies use upstream external sources of technology, resources and products from suppliers. Changjiang has developed innovation partnerships with world-class suppliers, and keeps in close contact with them regarding new product improvement and labour training. Huize uses advanced materials and components in production and obtains technical assistance from its trustworthy supply partners. Leo collaborates with other industrial partners to bring a co-evolutionary technology solution to its end customers. To obtain technological support for their innovation enhancement, small firms often engage in networking all along the production value chain. In value chains, firms are more familiar with each other and may pursue mutual goals with higher levels of trust (McCutcheon & Stuart, 2000; Tan, 2005). Chain partners strongly influence innovation activities, and customers are strong determinate actors in SME innovation processes. The Leo company and its key industrial customer-partners work together to create joint engineering

innovations. The large and powerful customers play a central role in driving innovations throughout the industrial production chain. In the case of Xiwo, this small company shares technology and resources with its large customers based upon their long historical relationships. It appears that innovation through external partners on the supply chain is central to innovation for the case-study SMEs. Chinese case SMEs rely more upon customers and suppliers than research centres or universities. The analysis shows that the strongest and closest innovative collaboration relationships are value-chain partnerships.

Government agencies

Political connections have often been considered valuable for Chinese enterprises (Qiao, Fung, & Ju, 2013). Several of the case-study firms have built extensive networks not only with business players but also with relevant government officials. Firms consider government and administrative entities as sources of financial support or for other purposes. Leo developed close political ties with local government organisations to obtain information and funding, as well as opportunities for government procurement. Win-all accessed the public stock market to increase its external financing opportunities by networking with officials of the stock market and government administrative agencies. A firm with close political ties may receive more government support. Leo also received innovation funding for its R&D innovation projects and obtained short-term credit from a government-supported programme to establish its subsidiary.

Universities and research institutions

Research collaboration can improve existing expertise and even create new knowledge for technological innovation. The case-study firms as a group have several complementary relationships with scientific partners, such as academic institutions, universities, university-based consultants and personnel. SMEs extend their innovation and technology-related networks with these scientific partners to gain access to advanced knowledge and technology. The Changjiang company started its smart grid research in association with two universities. Leo receives spill-over technology from its parent research organisation. There is usually collaborative networking with universities or research institutes in

knowledge-based or science-based SMEs, because these kinds of firms often need a higher level of technological input. For instance, Win-all has strong academic ties with the scientific community and has engaged in cooperative research projects with different universities and research institutes to reduce R&D risks and to shorten the time to market.

Industry associations and consulting firms

Industry associations, such as professional associations and trade associations, provide an informal interaction platform for SMEs. They bridge relationships between different organisations, acting as intermediaries or brokers in networks. Business association networks and technology association networks both positively affect innovation in SMEs (Qiao, Ju, & Fung, 2014). Qiao et al. (2014) conclude that SMEs can expand external relationships by joining industry association networks to catalyse innovation activities. Some of the case-study SMEs actively participate in the organised activities of industry associations to broaden their business contacts so as to promote sales or to learn from other leading firms. Industry associations play another important role at the start-up and initial network development phases of SMEs. Xiwo found its first important customer and built up sales ties by attending events staged by an electronics industry association. The president of Changjiang, Mr Wang, is also the head of the Wuhan Association of Small and Medium-sized Enterprises. Huize uses China's national medical association as a medium to promote its brand and advertise its products. Many SMEs lack managerial resources. In order to change this situation, the Changjiang company procured managerial knowledge from an external consulting company for manpower training and to reinforce effective management skills.

Other partners, complementary actors and professional individuals

Many firms extend additional networks with other partners. Huize expands its commercial activities by building strong relationships with local distributors, using distributor sales channels to market and deliver its products. By connecting extensively with local agricultural extension agencies and seed dealers, Win-all uses these complementary actors to strengthen its market power in China's main rice-producing areas. In addition, SMEs seek technological advice from their external network of

various contacts or technical experts. Some enterprises hire specialised consultants or invite external professionals to take part in their research and technology development processes. For instance, Leo hires external technical scholars from universities to assist in enhancing the technology capabilities of the firm. Xiwo invited an experienced professor to participate in its R&D when its invention ran into technical problems. Win-all received advice from six scientists at the early research stage of breeding new seed varieties. Huize employed retired experts to guide it in obtaining clinical permissions. The supplementary competencies of various partners and the knowledge of external experts are enormously helpful input in the innovation process.

The innovation patterns of Chinese case-study SMEs

This research attempts to enhance the understanding of existing innovation patterns in Chinese SMEs. The empirical findings show that the sample SMEs adopted a broader approach to innovation. The actual innovation activities in the Chinese case-study SMEs appear comprehensive and heterogeneous. The types of innovation investigated in this study can be subdivided into different categories. I identify and distinguish the key types of SME innovation practices in Table 12.

Table 12. The actual innovation activities of Chinese SMEs

Sample of Chinese SMEs	Type of innovation	Innovation activities
Shanghai Huize Medical Instruments Co. Ltd.	Market	Market-focus innovation
	Product	Product-specialised innovation
Hubei Changjiang Electric Co. Ltd.	Market	Market-driven innovation
	Product/process	Supplier knowledge-based innovation
	Product	R&D proactive innovation
	Organisation	Talent-centred innovation
Shanghai Xiwo Electrical Apparatus Co. Ltd.	Market	Customer-oriented innovation
	Process	Cost-efficiency innovation
Shanghai Leo Laser Equipment Co. Ltd.	Process/market	Cooperative innovation
	Product/process	Spin-off technological innovation
	Process/service	Service-related innovation
Win-all Hi-tech Seed Co. Ltd.	Product and process	Research-intensive innovation
	Market	Market-networking innovation
	Process	Risk-related innovation

The case-study SMEs have fairly diverse innovation activities, and they display more than one kind of innovation patterns. Thus, innovation management in SMEs has to be viewed from a variety of perspectives. Going beyond descriptions of innovation practices in Chinese SMEs, we can see that innovation is neither simply input and output nor a multi-stage, linear path from concept to commercialisation.

Simply put, more innovative companies are more successful than less innovative firms. Among the five cases, we can see the difference between the faster-growing SMEs and the slower-growing SMEs. Two firms have achieved superior growth and business performance. They maintain high growth and exhibit a higher degree of innovativeness than the other three SMEs. The Changjiang company has grown from a small firm to a middle-sized firm in a short time. The Win-all company has been successfully listed on the public capital market and has acquired

seven other small firms. The analysis yields the findings that fast-growing SMEs are likely to pursue more proactive and comprehensive innovation strategies in accordance with their different development stages. They are able to use a variety of internal and external resources and regularly develop new ways to organise their businesses. We can distinguish between more and less innovative SMEs. The more innovative SMEs are engaged in several innovation activities that result in faster development than in less-innovative firms. Zhang et al. (2008) discovered that firms with a clear growth-oriented vision and mission are more likely to achieve rapid growth. The results in the present study are in line with much other research suggesting that firms with high innovation intensity perform better than firms with low-intensity innovation (Schramm et al., 2008). The more innovative SMEs achieve better performance by using a wide array of external sources. They develop a supportive network of complementary business skills, linking up with external sources of innovation. Furthermore, medium-sized firms demonstrate more progress in systematic implementation of innovations than smaller ones. Because those firms have established a modern enterprise mechanism and organisational structure, their development can be faster. However, the discrepancy may also influenced by industry-specific features or the stage of development.

6.2 Empirical conclusions and discussion

6.2.1 The main innovative features of the case-study SMEs

Undertaking more process innovation than product innovation
The research found it was quite common that many case-study SMEs do not have a dedicated, internal R&D department. Research and development tasks are part of the general technology department. Their R&D efforts are distributed across a number of production processes and technological operational areas, rather than concentrated within a single formal R&D function. Moreover, even though many SMEs realise the importance of innovation and invest in technology and R&D, and all the case-study firms insisted that they are heavily involved in R&D, the fact is that their R&D spending is not especially high, averaging less than 10%

of turnover. High-tech SMEs spend a little more on R&D in terms of technical equipment and staff. From the opinions expressed in most cases, R&D expenditure is not closely associated with successful innovation. Affordable R&D input and inexpensive technological solutions may lead to the best innovations. Most case-study SMEs spend appropriate sums on R&D, taking into account the necessary balance between profit and risk. They are involved in process improvements rather than product developments. Their R&D activities strive to develop relatively new technology but less expensive products, in order to please their customers. Many product innovations are not entirely new but are actually significant improvements over existing products.

Incremental innovation is a major type of innovation

The majority of case firms follow the incremental innovation model rather than the radical model. Because of the high uncertainty and cost required for SMEs to engage in radical innovation, they prefer to invest in less risky and costly activities to generate innovation. SMEs are reluctant to invest massive resources into conducting product innovations or initiating highly risky R&D projects. A large number of innovations in Chinese SMEs are incremental, and they share an orientation to value-added creation.

Technology or R&D innovation, alone may not lead to business success. Investing heavily in R&D alone is not sufficient to gain a competitive advantage. In this study, Chinese SMEs were found to be taking relatively modest technological approaches to their innovations and business operations. To avoid high R&D risk, they looked for small-step changes to upgrade technology and focus on matching technological and marketing innovations. They prefer to deploy a mixture of technologies and products to offer "good enough" solutions. Engaging in a great number of different incremental innovations may lead to some radical innovations, but none of the case firms demonstrated this phenomenon.

The firms have a strong market orientation

We can see from the case analysis that Chinese SMEs often put markets demand and customer needs as their first priority. They make market-based innovative efforts, with greater focus on customer- and market-

oriented novelty rather than technology-oriented breakthroughs. They focus fundamentally on different commercialisation models instead of technical achievements. The "market-pull" demand mechanism more influences Chinese SMEs on the direction of new product development. The case firms place greater emphasis on product-market combinations, meeting customer needs by ensuring reliable, quality products at competitive prices. Many demonstrate a strong market orientation and respond promptly to market opportunities. In order to deal with intense market competition, Chinese SMEs put more effort into the commercial possibilities of technological innovation than into pure scientific research. Their product development is largely demand-led. The innovative orientation highlights feasibility and strongly incorporates market trends and customer demands into technological development.

Being better, being faster than other small firms

"Doing what we do but a little better than other small firms in product quality, service, and delivery, being one step ahead of the market." (Technical Manager of Changjiang) Compared to many other Chinese workshop-based SMEs, the five case firms are innovators who have shown sustained growth. They are profitable and have achieved good performance that is well above the average industrial level of their competitors. According to the case interviews, the managers confirm that their new product and process development are best kept primarily in-house, maintaining core technological capability within the firm. This reflects their viewpoints on innovation. They believe that independent innovation is a cornerstone of the firm, which is the first source of technology. Internal resources and capabilities within the firm are crucial. Their innovation activities rely largely on their own distinctive capabilities, early adoption and constant enhancement. The sample firms stress on building their own capabilities in different ways. However, each has its industry-specific characteristics. There is a positive connection between innovation and high competitiveness. The competitive advantage of SMEs relies on continual improvement and innovation. The data analysis suggests that the multiple capabilities are associated with superior business performance and sustainable SME growth. Many case companies are struggling to leverage their limited resources and financial restrictions to be innovative. Despite the fact that technological

innovations remain mainly in-house, as a general trend there is increasing collaboration with external organisations in the innovation process.

Specialisation, customisation and flexibility

The results demonstrate that the distinctive characteristics of Chinese SME innovation behaviour emphasise specialisation, customisation and product flexibility. Small case firms engaged in market or technological niches implement innovation-focused strategies to be more efficient and effective. The case-study companies have positioned themselves well in specific segments that large firms have not yet covered or specialised in certain products that large firms do not provide; this is how they stay their competitive edges. Each case-study firm has its own specialty. They focus mainly on the domestic Chinese market rather than the international market and specialised products or technologies for niche markets rather than mass markets. All the sample companies emphasise meeting the demand of the Chinese market and produce largely for the domestic market; only two companies export to other countries in Asia. The achievement of technological excellence in a specialised niche market can lead to competitiveness in the market. Furthermore, the sample of Chinese SMEs demonstrates sufficient flexibility in exploiting innovation in response to market or technological changes. It suggests that the wide adoption of appropriate innovation strategies is very common in Chinese SMEs. The sample firms strive for more flexible specialisation of production and the adoptability of new technology. The competitive advantages of these firms come from their greater flexibility and more rapid responses, as they are able to implement new services and launch new products more quickly and efficiently than their rivals. Their innovative flexibility not only relies on their skills, strengths and in-house knowledge bases, but also on meeting market demands. Chinese case SMEs have shown more nimbleness in their business operations, more effectively adapting to changing market conditions and moving quickly when facing competition.

Increased focus on patenting and licensing

Intellectual property is closely associated with a firm's innovative efforts. The five case SMEs apply and implement quality-control techniques in

their manufacturing or production processes; all have passed international and national standardised quality management systems, such as TQM, Six Sigma, ISO 9000 and ISO14000. The adoption of total quality management signals a commitment to innovation. The case firms are more active in acquiring industrial certificates and manufacturing licenses. All have their own or shared patented technologies or products. Prior research has demonstrated that innovative firms are prone to making greater use of intellectual property rights (Baldwin, 1997). The possession of intellectual property and obtaining international technical licenses are vital for SMEs. Chinese SMEs have gradually become aware of using intellectual property rights to protect their new products or proprietary technologies. They have become more concerned about their technological assets. The managers interviewed noted that patent protection is very important for an SME in order to deter other firms from imitating its innovations, but they do not believe that current legislation can provide sufficient protection for innovation and technological achievements. They thus not only utilise IPRs to protect their patents or technology secrets, but also deploy other methods to safeguard their intellectual property. For instance, they use confidentiality agreements, information secrecy and keep their R&D staff in-house. There remains a lack of legislative protection for IPRs in China. The rules of patent protection in China are still inadequate (Li & Zhang, 2007), and especially lacking in regulations to protect non-technological innovations. Under these circumstances, Chinese small firms still innovate independently, and there will not be an easy transition to an open mode of innovation. Most technological innovation activities still occur in-house, and companies are hesitant about an open approach to innovation, because of the absence of a well-established institutional framework regarding IPR protection. Therefore, it is necessary for the government to stress the enforcement of intellectual property law and to cultivate a satisfactory environment of legitimacy for SMEs.

Top-down innovation approach

As we have seen, power is centralised in the case of SMEs, although the best leaders are open to suggestions. The entrepreneurs steer the strategic innovation, and most new ideas arise out of his or her experience. This means that most innovation strategies are formulated

by owner-managers in a sort of entrepreneurial experience-based innovation approach. The innovative vision is shared and communicated from top down through the organisation. Management in many SMEs can be described as informal and entrepreneurially-oriented, lacking established routines and procedures, although the organisational structure in the fastest-growing case firms tends to learn toward a modern enterprise. The innovation processes are generally managed and organised from the top to down. In all cases, the top management is directly involved in innovation activities, which shows an executive-driven, top-down process. An entrepreneurial orientation was a central characteristic of the Chinese SME case studies. The top managers display a taste for innovativeness, proactive assertiveness and a willingness to take risks. The top-down hierarchical style that exists in the Chinese case firms results in quick decisions and executing innovations more efficiently to react to opportunities. In summary, top-down management leads to innovation efficiency that helps SMEs cope with turbulent and uncertain environments. However, it may restrict some creativity and new idea generation from the employee side.

Involved in extensive external connections

The findings show that the Chinese case-study SMEs are embedded in local networks and tend to operate in networks in order to gain innovative resources. This study demonstrates that the cooperative innovations in Chinese SME are based mainly on participation in vertical business networks and interactions with customers and suppliers. This means that the majority of SME innovations are carried out within supplier-producer-customer chains.

In addition, the interview data shows that many SMEs have more extensive external connections with diverse organisations, using a variety of external sources for innovation. More collaborative relationships with external partners are emerging for mutual benefit. This finding is consistent with several other empirical studies reporting that innovative Chinese SMEs are now engaged in broader networks with multilateral partnerships (Malik & Wei, 2011). Moreover, small firms maintain close connections with large firms, forming partnership networks to overcome market and technology limitations. Nooteboom (1994; 1999)

acknowledges that interactive complementary relationships between large firms and small firms tend to support innovation.

Innovation barriers in Chinese SMEs

Chinese SMEs face many barriers in their attempts to be innovative. Recently, they have been suffering from finance shortages and rising labour and raw material costs. [16] A lack of skilled personnel is one of the most important barriers faced by Chinese SMEs. All case study firms complained that they were not able to recruit enough qualified employees. This reflects a common problem in China, where SMEs have difficulties recruiting and retaining highly-qualified labours, especially technologists, scientists and higher professionals. At present, labour costs are increasing greatly; the massive pool of cheap labour no longer exists. Meanwhile, SMEs face challenges in attracting well-rounded talent, such as technical staff with scientific expertise who also understand the market. Under the free mobility of the Chinese labour market, good employees are reluctant to stay at small enterprises and are prone to leave when better jobs become available. The turnover of skilled employees is extremely high (Deng, Hofman, & Newman, 2013).

Limited access to external financing is another major challenge for the case firms. SMEs face many more obstacles than large companies. SMEs lack finance to start up and to expand. Their starting capital for venture investment comes mostly from personal savings or from family and friends. Prior research shows that SME owners in China have relied mainly on financial support from their own savings and immediate family (Hussain, Millman, & Matlay, 2006). Wang and She surveyed 53 Chinese SMEs in Zhejiang province and arrived at the same conclusions.[17] In my sample, the original venture capital of Huize, Xiwo and Changjiang were all from the founder's personal savings or from their personal relationships. Many Chinese SMEs have little chance of obtaining bank loans due to their small scale and limited credit histories. Banks are more cautious and conservative about reviewing loans for smaller enterprises. The Chinese banking system was designed for large state-owned enterprises rather than for SMEs, particularly privately owned SMEs (Huang, 2009). It is often difficult for small firms to attract

[16] http://news.xinhuanet.com/english/indepth/2013-12/12/c_132961871.htm

[17] http://www.seiofbluemountain.com/upload/product/200911/2006zxqyhy01a1.pdf

the financing needed to carry out innovation. The Win-all firm is a unique case in this study; this company successfully raised capital from the public stock market. Very few SMEs can achieve such success and have that kind of good fortune. Only a small proportion of innovative and high-growth small firms can access the Chinese public equity market. A large number of small firms have to finance their innovative activities through internal capital or informal sources.

China's government offers two kinds of tax incentives, including tax cuts and tax relief to help with SME financing. To encourage technology innovation, the government implements a preferential tax policy on high-tech firms. Three case-study firms, Changjiang, Win-all and Leo as "high- and new-tech enterprises", have benefited from these tax preferences, which apply a 15% tax rate instead of the normal rate of 25%. Zhu, Wittmann, and Peng (2012) identify five institution-based barriers to innovation in Chinese SMEs, including limited access to financial support, insufficient support systems, and unfair competition from large firms.

In recent years, China's government has gradually paid more attention to SME development and financing, enacting encouraging laws and policies in S&T and establishing many support programmes to nurture innovative behaviour among SMEs. For example, the Chinese government has set up R&D funds to stimulate SME innovative activities. The innovation fund for technology-based SMEs was launched in June 1999.[18] It seems the Chinese government tends to incentivise SMEs to invest more in innovations. The Ministry of Science and Technology (MoST) distributes innovation funds to SMEs to reward technological innovators. For example, Win-all received special agricultural science and technology grants, and Leo received innovation funding for R&D projects. Governmental financial support for innovation has had a significant influence on the financial growth of Chinese SMEs (Yu & Peng, 2013). Meanwhile, as one of the Chinese government's missions, supporting SMEs was restated in China's 12th five year plan in 2013.[19] A number of policies designed to promote more funding have been amended in recent years (Liu, Simon, Sun, & Cao, 2011). The implementation of laws and regulations, however, may take

[18] http://rightsite.asia/en/article/chinas-innovation-fund-supports-high-tech-startups

[19] http://www.gov.cn/zwgk/2013-05/29/content_2414100.htm

time to demonstrate its effects. Although the sources of financing for SMEs have become broader, most SMEs do not have access to political connections.

Overall, the Chinese government makes inadequate investment in SMEs that cannot meet their own capital requirements. The innovations of Chinese SMEs are hampered by insufficient public R&D funds. Meanwhile, many SMEs are unaware of available funding or are unsure how to enrol in the programme. They have reported difficulty accessing public funds, because obtaining government innovation grants is considered a heavy administrative burden and very time-consuming. SMEs often need capital quickly to finance their innovation projects. The complex and confusing government funding application procedures are difficult for SMEs. Although some have received government funding, that financial support is nowhere near enough. The scale of government innovation fund grants average 10% of the total R&D input budget. Small enterprises mostly have to invest in R&D projects or other innovations themselves. The Leo case illustrates this situation. Furthermore, the Chinese public service infrastructure is still in the early stages. There is a lack of institutional support for information and less government consultation and fewer services regarding matters such as new venture guidance and mentoring, business information services and financial advice. The asymmetry of technology and market information is also a barrier for Chinese SMEs. Local governments need to strengthen advisory services for SMEs by providing technology and management consulting services, market information services and the like.

6.2.2 Summary

The study shows some evidence that innovation is generally related to success among the SMEs in the sample. There is a positive connection between innovation and performance. Innovation is a powerful engine with which to ensure the survival and expansion of firms in a highly competitive market. The emphasis placed by SMEs on innovation leads to better performance in business. Innovation in enhancing capability and gaining resources that contributes to the SME's success. More innovative SMEs also tend to be growth-orientated. Overall it seems that Chinese SMEs have become increasingly innovative and proactive, going

beyond mere cost reduction or operational efficiency. The sampled enterprises display an ambition to grow with long-term innovation goals.

From the case analysis, we can see that Chinese SMEs have already demonstrated some achievements with respect to innovation. My research findings are similar to the results of a previous study by Tang & Tang (2010), who conducted an SME survey in northern China. The strategic operations of Chinese SMEs evolved from the defender strategies of a decade ago to the analyser strategies, and some are now moving towards more aggressive prospector strategies. There is a distinct trajectory of innovation in Chinese SMEs, shifting from simple to more sophisticated technological activities, from low-cost innovation to value-added innovation. This exhibits some similarities to situations in many other developing countries. In some industries, Chinese firms are developing from being technology followers to technology developers and even technology leaders (see e.g. Fan, 2006; Low, 2007).

In the last chapter, the within-case analysis revealed detailed information showing that SMEs differ in their innovation practices. The results demonstrate that the innovation activities of Chinese SMEs are complex and heterogeneous, emphasising different aspects of innovation. There is no single archetype that adequately summarises innovation in SMEs. SMEs have distinctive features, entrepreneurs and environments that play large roles in determining their specific approaches to innovation. This research shows that SME innovation behaviour is not the same in different firms. They vary in relation to their specific industries and their underlying innovation strategies.

In this chapter, the cross-case analysis empirically supports the argument that there is a wide array of innovation patterns existing in SMEs. All the firms interviewed have different innovation activities and practices. SME innovations are heterogeneous, concerning a variety of development paths and innovative actions. Small innovative firms have survived and grown by deploying different forms of innovation though most increasingly use networks in their innovation activities. However, the Chinese SMEs investigated here do not use their innovative competencies as fully as they might, and there is definitely room for improvement. The empirical data suggests that there are a number of core elements to innovation. I have formulated a conceptual model, an integrative framework consisting of processes, stages, elements, actors

and feedback loops. This model can be seen as a strategic approach to SME innovation management. I make some explicit theoretical statements in this regard in Chapter 7.

7 CONCLUSIONS, CONTRIBUTIONS AND LIMITATIONS

7.1 Limitations of the study

This research used multi-case studies and a multi-informant process to identify innovative activities in Chinese SMEs. Inevitably, the study has a number of limitations and biases. Before going into the theoretical and managerial contributions, I address some of the limitations in this dissertation. The following is an assessment of potential biases in this study.

Sample bias
The potential problem of sample bias is considered in this research. The empirical outcomes are derived from a small set of Chinese cases. Due to the study purpose and research questions, the data analysis was conducted on the basis of a small-scale sample of firms. The sample size is too small to obtain unbiased conclusions. Although the case-study firms represent several industries, the narrowness of scope makes it difficult to make generalisations across SMEs or sectors. There may also be a potential selection bias. The selected SME samples are not representative in reflecting the comprehensive business phenomenon. All case firms are located in the Yangtze River Delta area; they might not represent the whole Chinese SME populations in general. It is thus impossible to extrapolate the results to all SMEs in China. In addition, the cross-section data is not sufficient to explain cause and effect relations in full detail. It is useful to note the distinction between those cases within the primary and secondary industries of agriculture, automobiles and pharmaceuticals that are represented here as high- and medium-technology industries. Moreover, the empirical evidence is taken solely from small- and medium-sized Chinese firms, any knowledge is generalised only to a specific country. Due to the country-based differences in the political, market and economic environments in

which SMEs operate, there might be differences in innovation patterns in other countries.

Response/interviewee bias

Innovation is identified and measured on the basis of perceptual, self-reported data (see e.g. Hoffman et al., 1998). In this research, most of the primary data, such as sales, profit, and employment information, was gathered via personal interviews. The innovative achievements and performance of sample firms were largely identified by informants employed by those firms. They understand innovation in their own ways. The informants provided self-reported data which was based on introspection and retrospection. A large amount of the data is subjective in that it is derived from informants' own experience, opinions, and self-evaluations of their companies. This can generate bias. Meanwhile, the company's performance, profitability and market share growth were measured on the basis of self-assessments by the interviewees, and thus reflect each individual's perspective. Normally, interviewees are prone to over-assessment of innovation activities in their companies. However, self-reported measures are appropriate when objective data is not available (Dess & Robinson, 1984). In addition, for confidentiality considerations, the case-study companies were reluctant to provide negative or sensitive information, although there was a certain amount of mutual trust, and I did promise not to divulge any important information. Some interviewees were very cautious about some sensitive questions, and were hesitant to speak. They did not want to disclose their actual technological issues in more detail, which caused difficulties when evaluating their actual technological levels.

Data bias

The captured data has a number of imperfections. Large amount of qualitative data was collected mainly from observations and interviews. Much data is not publicly available, especially for smaller and privately owned organisations, although I tried to minimise this bias by seeking other sources of data. There is a shortage of secondary data available from other sources to verify authenticity, except in the case of Win-all Company, which is a small firm listed on a public stock exchange and thus does release richly detailed information to the public. Given these

realities, it was effectively impossible to triangulate the findings to answer the research question. Meanwhile, the data from each case is not symmetrical, which may have unpredictable effects on the results of this research. Additionally, all data was collected at one point in time, and innovation trends in Chinese SMEs are dynamic and change rapidly, so deploying a longitudinal study might be a worthwhile effort in future research.

Researcher-based bias

The natural weakness of the qualitative method is the emotionalist model (Gubrium & Holstein, 2002), referring to "the individual's point of view" and "the actor's perspective". A researcher's personal preferences, prejudices and position in relation to the research object may all affect the results, and to be frank, those emotional elements do more or less influence my study. However, I strove to maintain a neutral attitude and stance throughout the research process.

No research investigation is absolutely neutral. As stated by Eriksson & Kovalainen (2008) that researchers more or less bring their own special interpretation in the research, they are all at least partly based on personal behaviour. Researcher self-discernment means that the researcher uses their own judgment about whether information is valuable, useless or somewhere in between. This is because the researcher is part of the process, and different interpretations affect the research process in complex interactions. I was the only researcher involved in the process of the case study design, asking questions, collecting data, analysis and interpretations. I worked alone throughout the entire research process. I designed the questionnaire, conducted all the interviews and analysed all the empirical data. As a researcher, I went through all interviews to obtain a sense of the real phenomenon. I was responsible for translating and summarising what was heard and condensing and interpreting the flow of meaning. The data coding procedure was a highly intellectual effort based on my own insights, perceptions and interpretations. I classified the various meanings and put them into categories and patterns. I named them based on my own understanding of the evidence. This is my first time conducting either such in-depth interviews or multiple case studies, although I had experience in data collection from my master's degree education. The

research report is more or less influenced by my personal understanding, knowledge background and academic experience. In addition to other limitations, I lack a technological background, so it took me a long time to comprehensively understand some of the technologies. I offered my own judgment about their degrees of innovativeness, according to the technology level and performance of the sample firms, which might have involved some bias.

Model bias

This research is a typical exploratory study. The innovation model that I propose later here in Chapter 7 is a generic model. It could be criticised for being too general, vague and all-inclusive. This model contains an overall view of all key aspects of the innovation process. However, this kind of viewpoint is not yet well understood among SMEs. It could be argued that SMEs may not able to operate using all aspects of this model, because of their relatively small size and resource constraints. There are good arguments that SMEs rarely have sufficient capacity to manage the entire innovation process. Nevertheless, this model provides a holistic approach designed to guide SME to think about the different perspectives on strategic innovation, and even encourages them to engage in networks with other firms or entities. The fact is that SMEs may focus on some key factors and particular aspects in the innovation process at different stages and market situations. Therefore, it is necessary to focus on these aspects to carry out future research. In addition, a single framework is not sufficient for all situations. The model proposed in this thesis addresses all dimensions of an organisation-wide innovation system, and I did not expound details in great depth. At the least, the generic innovation model makes a novel contribution to the knowledge of innovation management and has potential for further development. The model needs more testing and evidence to demonstrate and refine it. Future research will need to determine whether the model can be applied to more cases. It would be especially useful to aim for a more precise implementation of innovations in SMEs.

Level/position bias

The current findings are based on one level of analysis. As mentioned, I employ firm-level empirical data to analysis the Chinese SME innovation behaviours at a strategic level instead of an operational level. Moreover, all evidence comes from product-oriented small and middle-sized enterprises, so the research results might be more useful for manufacturing firms than for service firms. Service firms may well have different innovative patterns. Moreover, this research would also be fruitfully used to explore selected issues in greater depth or from different perspectives. For instance, all samples are located in enterprise zones or science and technology parks; in a future study, it might be worthwhile to examine these firms from a cluster viewpoint. Furthermore, as a researcher located outside the firms, although I held several interviews, it was nevertheless difficult to me to gather all the information that exists about each firm.

7.2 Theoretical contributions

Normally, SMEs have size disadvantages, such as a lack of human and financial resources, inadequacy of management and marketing skills, limited external information and connections, and difficulty in coping with government regulations; such disadvantages may cause barriers to the development and launch of innovations (Liao, Kickul, & Ma, 2009; Narula, 2004; Nooteboom, 1994) and limit their competitiveness (Freel, 2000b; Rothwell, 1994). Therefore, innovative operations tend to be considerably more challenging for SMEs than large firms. On the other hand, SMEs are less bureaucratic, react quickly and are more willing to take entrepreneurial risk (Dhawan, 2001; Tornatzky & Fleischer, 1990; Vossen, 1998). It has been proven that the most innovation efforts are made by the firms themselves (Nelson, 2000).

The emphasis of this study was on analysing the internal and the external factors which affect SME innovativeness. SME innovation relates to a variety of elements and is determined by internal factors, the external environment and the interactions between the two. Internal and external factors are both important. However, the factors influencing innovations differ across countries and industries. The effort to promote

innovation comes from the internal organisational perspective. In other words, innovativeness mainly stem from inside of the companies rather than from the external circumstances (Konsti-Laako, Pihkala, & Kraus, 2012). The external environmental contains exogenous factors. An enterprise's own innovative abilities are crucial for accelerating innovation and determining innovation success, even if it is external factors that make innovation necessary. SME innovation may be externally influenced, but it is always facilitated internally.

Innovation requires a wide variety of knowledge, skills, resources and capabilities. It is a systematic process and should be planned, organised and implemented strategically. Innovation strategy has been identified as an important determinant of a firm's direction (Lawson & Samson, 2001). SME innovation is often at the individual entrepreneur's innovation level and has not yet been translated to the strategic level. SMEs should seek overall improvement in their innovation activities. Innovation capability is one of the most important dynamics by which SMEs achieve competitive advantage. I see innovation capabilities as the result of an integration of various internal and external influences, while a firm's innovation capability can be regarded as a necessary requisite for developing a set of complementary business skills. In other words, SME innovation depends not only on internal R&D, but also on acquiring more and more outside knowledge and resources. It is important for small innovators to obtain the right complementary resources. SMEs need to understand the interconnected nature of the innovation process and how key elements of a firm's innovation process can strengthen its competitive advantage.

A major problem is that many small firms innovate on an informal basis. They lack a strategic vision to exploit their ability to continue to innovate. Moreover, SMEs are less often engaged in networks than larger firms, and make limited use of networks for innovation. To ensure survival and growth in a fast-changing market, SMEs have to master innovation strategically. SMEs need to frame their inner and outer innovation structures in a way that helps them become more competitive (Bessant & Tidd, 2007). In this research, a conceptual model is developed to highlight the three key processes in fostering SME strategic innovation. The model of strategic innovation is generated on the basis of previous theories and the empirical results of the case studies. It is an

integrative model for SME innovation. Innovation advantage is inherently temporary, and SMEs need to manage and facilitate innovation in an integrated way to ensure continued success. This conceptual model is formulated on key internal and external factors. It can be divided into the three-way loop shown in Figure 16. This innovation model focuses on processes, actors and networks. It integrates core innovation elements that represent management best practices. Unlike the traditional linear model, this cyclical model can be characterised as a systematic approach that contributes to SMEs establishing dynamic innovation capabilities and obtaining sustained competitive advantages. There are three loops in the model:

- a primary innovation loop
- a dynamic learning loop
- a strategic decision loop

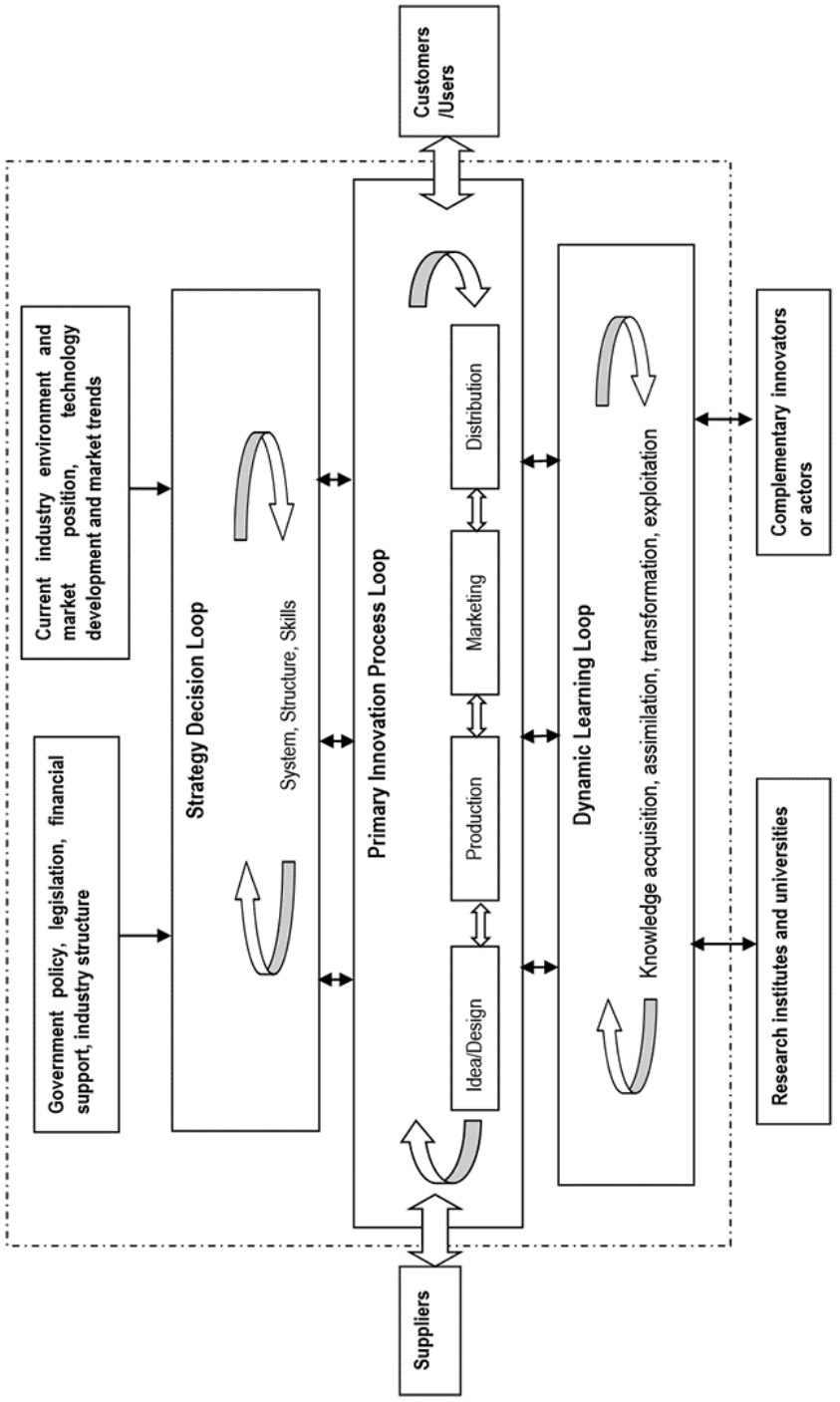

Figure 16. An integrative innovation model for SMEs

A primary innovation loop: This is a basic level loop containing the core innovation processes from an idea, through various stages of development, to a final market launch. Hence, it is termed an operational innovation loop. It comprises the following distinctive components: idea generation, design, production, sales and distribution. It represents the transformation of new product ideas or technologies into marketplaces. It focuses on a combination of technology and market. Small firms must carry out technological innovation to enable them to remain at the forefront of technological advances, and also undertake marketing innovation to realise successful commercialisation. SMEs that integrate technological and marketing innovations can develop more new products or launch the products to the market more successfully and faster than their competitors. This loop generates essential capabilities to increase technological advantages and marketing abilities. It is an interlinked process related to more effective communication, information-sharing and coordination across the different functional areas of R&D, production, marketing, sales, etc. SMEs should create a close working relationship between the different departments within the firm, transforming initial ideas into successful commercial products or services. This basic level loop is composed of different stages: idea generation, research design and development, prototype production, manufacturing, marketing and sales (Dooley & O'Sullivan, 2001; Rothwell, 1994); it is the integration among R&D and manufacturing, marketing and R&D and marketing and manufacturing. Meanwhile, the primary innovation loop should facilitate the matching of technological and market innovation to attain a dynamic equilibrium.

Furthermore, many SMEs lack of innovative resources and capabilities, networking allows SMEs to obtain the most important complementary assets. Innovation calls for collaboration outside company borders with business partners and even other actors. Developing cooperative innovation-related relationships with suppliers and customers is of vital importance. Firms with well-developed suppliers and customer relationships have better access to external technology (Mansfield, 1985; Urban & von Hippel, 1988). External ideas for innovation can come from many sources. Customers and suppliers are critical actors for exchanging innovative ideas and technological know-how that can contribute to guiding the innovation activities of

SMEs. An SME can benefit from customers and suppliers in terms of the cross-fertilisation of ideas and by developing product concepts during the product design stage (Lipparini & Sobrero, 1994). The most important partners in developing an innovation are customers. Tolstoy (2009) found that customer knowledge can spur knowledge-creating processes in SMEs. Through working with users, small firms can learn more about the particular requirements of customers and incorporate their needs into technological development. Strong relationships with customers enable SMEs to respond rapidly to technical and market shifts. Additionally, close interaction with suppliers allows them to be involved in the R&D process; small firms can not only improve their products but also gain tacit knowledge. Connecting with customers and suppliers may make small firms more flexible and increases their chances of success. This loop also provides an open environment in which to realise a strategic alignment of innovation elements. Innovative small firms depend on complementary innovators, moving from internal innovation processes to open, collaborative processes. Pursuing strategic partnerships or collaborations with cross-industrial innovators can facilitate access to critical resources for innovative developments.

In fact, some researchers claim that most advanced sources of innovation are created within networks (Chang, 2003). For small- and medium-sized firms, collaborative networks are essential for speeding up the innovation process. While networking has a positive impact on innovation output, it also helps SME to overcome size-related disadvantages. SMEs can obtain benefits from innovation networks, but their success depends on their ability to identify, interact, assimilate and exploit new sources of knowledge (Lichtenthaler, 2009; van de Vrade et al., 2009). A number of studies suggest that SMEs that interact with external organisations such as governments, research institutes and consultancies can ultimately increase their innovative capabilities. Complementary relationships can be particularly helpful in producing synergy to improve firm performance. If SMEs lack innovative resources, they must build up their networks to support innovative activities and gain the necessary assets. Networking with external partners and alliances allows a firm to tap into additional innovation resources. Firms involved in multiple types of ties are more innovative than those that only utilise one type of tie (Lee, et al., 2010). Successful small firms are

likely to keep up multiple inter-organisational relationships with different actors. Inter-firm cooperation and connections will have a strong impact on SME growth and performance (Terziovski, 2007; Zeng et al., 2010). By establishing business links, institutional links and social links, small firms are able to gain access to technological expertise and complementary assets, including resources for continuing R&D, production, marketing and management capabilities (Löfsten & Lindelöf, 2005). Collaboration can help SMEs to compensate for limitations by sharing risks and reducing costs, achieving economies of scale, expanding market shares and leveraging their competitive position (Bos-Brouwers, 2011). Additionally, the enhancement of cooperative competencies of trust, communication and coordination among alliance partners can contribute positively to a firm's innovativeness (Hausman, 2005).

A dynamic learning loop: This pertains to the process of knowledge acquisition and development, consisting of the ability to acquire, assimilate, transform and deploy new knowledge (Jansen, Van Den Bosch, & Volberda, 2005). Innovation is particularly about learning (Tidd, Bessant, & Pavitt, 2001, p. 19). Birchall and Tovstiga (2005) argue that successful innovation is strongly linked to the ability to gain knowledge, learning and change. Learning is a fundamental process placed at the third level of the innovation process in this model. Because the complexity of technology and product development requires different types of knowledge, the ability to learn new knowledge is a necessity for small firms so as to achieve technological catch-up and explore new businesses. The main learning process is identified by Zahra and George (2002, p. 189), which comprises of knowledge acquisition, assimilation, transformation and exploitation. It is concerned with strategically acquiring knowledge to create innovations. Knowledge is viewed as an invaluable resource for a SME's successful innovation. Small firms need to upgrade their knowledge continually to deal with a fast-paced industrial environment and vigorous competition. The knowledge involved in innovation activities can be tacit or codified and can be generated within the firm or acquired from external organisations. As for SMEs, learning capability has been increasingly identified as an antecedent to their survival and success (Chaston, Badger, & Sadler-

Smith, 2001). Increasing learning capability can significantly enhance the effects of innovation. Commitment to learning promotes a learning orientation, which leads to innovation capability (Verona, 1999). This process includes learning within the firm and interactive learning from outside the firm through links networks. SMEs can use a wider variety of knowledge input from a wider range of sources, which allows them to reach a higher level of learning.

SMEs need to make clear which types of knowledge exist within and outside the firm. On the one hand, knowledge in small organizations tends to be tacit and possessed by individuals. Van Wijk et al. (2008) and Rosenbusch et al. (2011) propose a positive relationship between intra-organisational knowledge transfer and firm performance. Small firms can develop new skills within the firm through internal learning, which includes individual learning and organisational learning that ranges from offering formal training to individual self-development and cross-training. Nonaka (199) confirms that an organisation cannot create knowledge without individuals; it needs to support its creative employees to create knowledge throughout the organisation. Unsurprisingly, a high level of employee involvement in the innovation process can produce more fruitful innovation outcomes. Employee participation at all levels in the organisation is an essential part of the innovation process. Many small firms are aware that highly educated and highly skilled workers are critical to a firm's success, and invest in the training of employees to ensure employee innovation skills (Mazzarol, 2003). The skills and qualifications of employees are important innovation resources (Chen &Huang, 2009). The most effective way is to create informal learning opportunities, such as cross-functional training, job rotation and apprenticeships to encourage knowledge development and know-how sharing throughout the organisation (Wong & Aspinwall, 2004). A shared vision of knowledge and communication in the different departments can enhance the overall quality of learning (Calantone, Cavusgil, & Zhao, 2002).

On the other hand, firms have to increase the diversity of their knowledge to be able to generate higher levels of innovation (Leiponen & Helfat, 2010; Miller, Fern, & Cardinal, 2007). Under fast-paced technological change, renewing knowledge on a purely internal basis is very difficult for SMEs. Some critical requisite knowledge and technology

for innovation may well and likely lie outside the enterprise. Thus, there is also a strong need to expand the breadth of knowledge from external sources, searching and absorbing the available knowledge from outside instead of relying solely on what is known and can be developed internally. Previous studies have shown that innovation can be accelerated by interactive learning, and SMEs involved in networks will be more innovative than those not in networks (Mohannak, 2007). External knowledge sources can increase a company's innovativeness (Chesbrough, 2003; Gassmann, 2006; Laursen & Salter, 2006), especially access to heterogeneous knowledge sources (Rodan & Galunic, 2004). A higher degree of supplementary knowledge has also been found to influence innovative performance positively (Knudsen, 2007). Different network ties provide firms with opportunities for learning (Tidd, 1997), and collaboration is an important mechanism for knowledge transfer. SMEs can develop and utilise inter-organisational relationships to gain access to various resources held by other actors. The widespread use of customers is regarded as an industrial knowledge source in SMEs (Vega-Jurado, Gutiérrez-Gracia, & Fernández-de-Lucio, 2008). Innovative knowledge may be transferred and diffused from different actors, such as universities, public or private research institutes, consulting firms and other complementary innovative organisations. Interaction with suppliers, customers, public assistance agencies, industry associations and the like can reveal information about technologies and markets, along with offering various complementary external input for the learning process. Many researchers have found a positive correlation between innovation and increased cooperation with universities and academic institutions, which is important for successful innovation in SMEs (van Hemert, Nijkamp, & Masurel, 2013). These external ties provide resources for SMEs to access a wider set of technological opportunities. New knowledge acquisition can lead SMEs to build valuable skills. SMEs can access and use the knowledge by interacting with various actors. Furthermore, firms should also have absorptive ability to transmit knowledge and technologies (Cohen & Levinthal, 1990). They must continuously update their learning capabilities to stay ahead of competitors. New knowledge can either be added to accumulated knowledge or used to replace older knowledge within the firm.

A strategic decision loop: This is an innovation-enabling process; it facilitates core capabilities based on management competencies, which directly brings the firm competitive advantage. Innovation is not just new idea creation but also involves systematic and structured management processes (Tidd, et al., 2001; Trott, 2008). The strategic decision loop ultimately influences innovation success, from organising and developing the innovation to making it work in practice. It is concerned with the redefinition of goals combined with the critical strategy, structure and system of the firm in the long run.

Strategy is associated with the overall purpose and long-term direction of the firm, expressing where the firm wants to go and how it can get there. Being a rapid innovator requires a clear and well-developed innovation strategy. A firm's strategy should fit well within the firm's strengths and weaknesses and the opportunities in its environment (Cobbenhagen, 2000). Small firms often employ effectual logic and iterative approach in the decision-making process at their earlier development phase or facing the uncertainty of innovation (Berends, Jelinek, Reymen & Stultiëns, 2014). However, strategic innovation in SMEs relies on a well-functioning system with appropriate flexibility. SMEs must be capable of flexibility (Fiengenbaum & Karnani, 1991), bridging between goals and resources. Flexibility allows firms to adjust their strategic plans quickly in order to pursue opportunities and respond to environmental changes (Baldwin & Gellatly, 2003). Most innovative SMEs have a flexible organisational system with less-structured routines that enables them to act faster in adopting new technologies and dealing with market changes. Prakash and Gupta (2008) found that flexibility may negatively affect the implementation of an innovation, so SMEs should maintain an appropriate balance between internal flexibility and control (Heunks, 1998), emphasising on what they can control by deploying the means in exploiting environmental contingencies (Sarasvathy and Venkataraman 2011). Drucker (1974) pointed out that structure is the means of achieving the purpose and goals of an organisation. Organisational structures can spur or hamper the implementation of innovation. Rothwell (1989) argues that small firms can have an innovative advantage due to differences in managerial structures. Innovative firms need to design an adaptive organisational structure (Meyer, 1996; Tidd et al., 2001). Larson, Gobeli and Grey

(1991) examined the relationship between management structures and innovation activities in small firms, suggesting that an appropriate matrix structure in project management can more effectively support innovation by encouraging the sharing of employees and resources across innovation activities. Adaptive structure is considered a significant part of SME's competitive advantage over large firms (Qian & Li, 2003; Terziovsk, 2010). A firm's organisational structure may influence their ability to pursue each type of innovation. An adaptable organisational structure consists of multi-functional or cross-functional teams that contribute to effective and efficient management of innovation (Laforet, 2011). Furthermore, entrepreneurs play a pivotal role in the formulation of innovation strategy in small firms (Mazzarol & Reboud, 2006). Successful innovation is thus bound up with top entrepreneurs. Strategic innovation decisions in small firms depend largely on top management. The owner-manager is at the central position in the SME in creating the firm's strategy. Therefore, entrepreneurs are key facilitators in the innovation process. Entrepreneurs may behave as leaders and inspiration and thus launch an innovation movement within the firm. The best innovation decision processes are steered by the entrepreneurs' attitude and behaviour, as well as their ability to identify opportunities, sensing key tendency of market or changes in technology, and proactive work on the gaps strategically (Mazzarol, Clark & Reboud, 2014). Skills are comprised of talents, know-how and experience. Human resources are critical elements in innovation activities. Employees are a source of ideas and the implementation of innovation. Investment in training to enhance the qualifications of the workforce is significant for innovation (Zheng, O'Neill, & Morrison, 2009). Human capital is seen as soft skills that are difficult for competitors to replicate or imitate; it can stimulate the emergence of unique capabilities over the long term. Meanwhile, it is necessary to promote an innovative climate to increase worker involvement, awareness and commitment to the innovation process, such as establishing an innovation reward system and an incentive mechanism.

External factors in SME innovation activities

A dynamic environment is considered of special importance to understanding SME innovation. The external environment plays a pivotal role in accelerating SME innovation, including government support, the circumstances of technology and the market. Environmental conditions determine the range of innovative opportunities upon which SMEs can seize. Environmental dynamism or turbulence always has an important impact on SME innovation activities.

The dynamics of the economy and the shifts of technology and market demand lead to greater challenges for SMEs. Innovation is spurred by intense competition and fast-paced technological change (Ravasi & Lojacono, 2005). To deal with a fast-moving environment, the speed of innovation is often a critical for success or failure. Rapid technological development and industrial revolution can make existing products obsolete that create new market opportunities for SMEs. On the other hand, those external changes force firms to obtain new technologies to introduce new products or services quickly. Small firms operating in an uncertain, turbulent and highly competitive business environment are likely to be more proactive. Market trends and technological development in the industry can have a positive effect on the innovation achievement of SMEs, depending on how rapidly SMEs respond to market and technological changes. The competitive situation in terms of industry concentration and barriers to entry are also closely linked to the fortune of SME innovations.

Government regulations and supportive policies can provide great opportunities for SMEs to access resources. Although government regulation is not the only factor that can positively impact the process of innovation, it is nevertheless an important one (Delaplace & Kabouya, 2001; Terziovski, 2007). Government offers funds to small companies for innovation-related projects. In fact, many small firms may not have sufficient information or a clear path to obtain innovation funds or assess the available external finance options. In a transition economy, small firms should adapt policy and legitimacy changes, making use of supportive policies. SMEs need to recognise and exploit institutional opportunities, not only being more aware of the types of public funding available from the government, but also trying to access multiple sources

of funding. SMEs should know how to utilise government political support or other financial sources to facilitate their innovative activities. Conversely, governments should create a better environment and easier access to promote the innovative development of SMEs.

7.3 Summary of the SME innovation model

This model is constructed as a strategic platform that enables synergy between all the elements of innovation. The multi-actor and multi-level conceptual structure delineates alternate strategic pathways to successful innovation. This integrated model is based on a number of key processes in innovation that are appropriate for SMEs. It presents an overview of a wide range of innovation strategies from the firm's perspective. It also shows that innovation is an ongoing process, an interactive process and a complicated process.

Fundamentally, a single loop is not sufficient to create innovations. SMEs need a holistic and systematic view of innovation management. The research in this study advises SMEs to go beyond the traditional focus on tactics. Small and medium-sized firms should place greater stress on obtaining their innovative resources and capabilities from a wide range of sources. This comprehensive innovation model is tailored to SMEs in promoting innovative thoughts and the choice of strategic decisions. The three parallel loops are intermingled to facilitate the flow of a dynamic innovation process, enhancing capabilities for innovation. Although this model offers an overall vision of the innovation process, it can be modified in the light of different organisational, technological and market contingencies. An SME that systematically builds innovation capability can see this result in competitive differentiation. This conceptual model can help SMEs to integrate, redeploy and reconfigure different skills and resources to stay ahead of their competition in a rapidly changing marketplace. In a word, SME should adopt a systematic approach, integrating the key elements of the innovation process. Every firm needs to tailor and adapt the model to incorporate its own resources and circumstances. To sum up, the success of SME strategic innovation depends on having the right capabilities to allocate the right resources at

the right times, along with the right entrepreneur to make the right decision.

7.4 Conclusions and future research direction

This study takes small- and medium-sized innovative businesses as its research focus. Today's dynamic and challenging business environment requires such firms to be more innovative in order to remain competitive and sustain growth. I obtained insight into the innovation activities at different firms and identified SME behaviours and innovation practices at the organisational level. Innovation is far more than R&D input and output. To be innovative, SMEs must consider how to organise and manage innovation strategically. The integration of the innovation process into the firm as a whole is an essential part of innovation. This study develops a comprehensive and systematic framework that guides SMEs toward successful innovation. This model is an integrated approach to the systematic management of innovation. It provides a useful approach for SMEs to strategically improve their innovation in accordance with their particular situations, resources and experiences. Using this model, SMEs may identify specific targets to accelerate innovativeness more effectively. This model helps SMEs seek alternative paths for managing and organising innovation with their own optimal patterns.

This research provides a more general overview of the theory and practice of innovation management in Chinese SMEs. Different factors impact strategic innovation decisions and models. A changing environment is an external driving power in providing opportunities and a greater competitive incentive for SMEs innovation. The entrepreneur is an essential internal driving force in the generation of innovation. Operating in fast-moving markets, SMEs need to innovate in terms of skills, experience and competence to meet the challenges of the market. Although there are many differences in innovation patterns within country-specific or industry-specific contexts, we can also find common characteristics.

Innovation needs to come first and foremost from within firms. SMEs should develop key technological items themselves. SME innovation

needs to be managed in an integrative manner in order to achieve sustained competitive advantages. This study recommends that SMEs pay special attention to developing their innovation capabilities, so that the entire innovation management process is systematic. We cannot take a narrow view of strategic innovation. This model brings many different elements together into an integrated whole. The innovation model is best viewed as a recurring and interactive process requiring intensive interaction internally across functions and externally with different actors. An innovative small firm should be actively cycling around the strategic decision loop, learning loop and primary innovation loop to remain continually innovative. The three loops encourage SMEs to cultivate a holistic view of organising innovation activities. An effective integration innovation strategy is critical to the survival and success of small firms operating in changing and complex environments. This study's contribution is in integrating the many individual and often disparate elements of innovation capabilities into a comprehensive conceptual framework that can foster successful SME innovation management.

This study gives directions for further research on the subject. In some ways, there still exists a lot of room for improvement and there are more detailed questions to be asked. There are differences in the competitive structures of individual sectors and firms. It would be advantageous to develop a large-scale empirical research project to explore this topic in greater depth. The elements of innovation capabilities identified and the conceptual model proposed in this study still require further empirical work. Indeed, I hope that my doctoral thesis will inspire future research into small business innovation.

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APPENDICES

Appendix A: Questionnaire

I. Respondent information

1) Name:
2) Department:
3) Position /title:
4) Level of education:
5) Tenure in office:
6) Work experience/ technical expertise:

II. Company's overall situation

1) Company-owned industries and industrial circumstances:
2) Year in which the company was founded:
3) Firm size: number of employees and departments:
4) Business founders:
5) Ownership and shareholders:
6) The main products and product lines, product life cycle:
7) The main sales markets: domestic _____ foreign _____
8) Market share: domestic _____ foreign _____
9) Main competitors: competitors' market share and market strategy
10) Information supply chain: customers, suppliers and distributors
11) Financial results: sales reports, revenue
12) The company's organisational structure and personnel distribution
13) The company's core competitiveness and resource advantages: technology, finance, human resources (staff quality), other
14) The company's business strategy: the company's mission and goals, long-term and short-term development plan, the overall strategy, the functions of strategy and innovation strategy

III. Innovation overview

1. How important do you think the development of technology and management innovation is in your company?

1) not important 2) less important 3) important 4) more important 5) very important

2. In your company, what is the purpose of innovation/motivation? (Multiple answers)
1) to become a technology leader?
2) to improve profit greatly?
3) to improve the company's core competitiveness?
4) to get rid threats posed by competitors' innovation?
5) to enable the enterprises to continue to grow?
6) to ensure the company's survival?

3. What is the main reason that your company engages in innovative activities? (Multiple answers)
1) In order to meet customer demand
2) To meet scientific or technical development
3) Due to intense competition in the market
4) Our business decision-makers' awareness of innovation and strategic vision
5) Suppliers' requirements
6) National/local policy incentives
7) Other

4. How would you evaluate your company's innovative model, using which of the following technology innovation strategies?
A. Technology-leading strategy
B. Technology follow-up strategy
C. Imitative strategy
D. Absorb and re-innovate strategy
E. Market application adaptation strategy

Remark: A. The technology is at the industry-leading level; B. The technology is keeping up with advanced enterprise level; C. The major technology is an imitation of other enterprises; D. Introduce and absorb technology and recreate it; E. Use existing technology in a new market.

5. Which level best describes your company's innovation?

Type 1: high innovation, frequently introducing new products, R&D and technology in a leading position in the industry
Type 2: based on existing technology, upgrading and introducing new products and services
Type 3: enhancing and improving existing products and processes to meet market demand
Type 4: market-oriented innovation, finding new market segments and extending market share

6. So far, which type of innovation has been undertaken at your company?
1) Product or service innovation
A. to create new products
B. to improve the technical content of products
C. to increase the functional usage of products
D. to design product upgrades
E. to find new applications for existing products

2) The production process innovations aim to:
A. reduce costs
B. improve the quality of products
C. enhance production efficiency
D. expand the product line
E. improve flexibility in responding to customer needs

3) Marketing innovation:
A. introducing new products in new markets to develop new markets
B. introducing new products in present markets to discover a new market segment
C. introducing current products in new markets
D. maintaining current production in present markets

4) Implement a new management or business mode?

7. What are the achievements or results of innovation?
1) Increased profit 2) sales growth 3) expanded market share
4) enhanced company's competitiveness

8.Who plays a key role in innovation decision-making?
A. The owners/leaders and their personal vision and decision; B. internal management team; C. R & D department; D. entire staff via discussions and suggestions; E. consulting agency; F. Other: _____

9.From innovative ideas to implementation, the process is:
A) top-down 2) bottom-up 3) both top-down and bottom-up

10. Combined with the actual situation of your enterprise, from your personal point of view, the main difficulties and obstacles in the process of implementing innovative strategies in China are (Multiple choices):

Internal:
1) shortage of funds
2) lack of professional R & D talent
3) the technology is too difficult, we do not understand the relevant technical and market information
4) R & D costs are too high, specifically the innovative achievements in industry costs are too high
5) Innovation is so risky that it is difficult to predict future market development
6) lack of long-term strategic development plan and the modern enterprise management mechanism
7) lack of innovation and strategic partners
8) channels of cooperation with universities and research institutions are poor
9) other (please specify):

External:
1) difficult to obtain finance
2) government financial support is not enough
3) adequate policies and regulations are not implemented
4) lack of Intellectual Property Rights protection
5) social and public services are not well-established
6) the cluster network of industry is incomplete
7) other (please specify):

IV. R & D investment and innovation capability of enterprises
1.The number of R & D staff: _____, the proportion of total staff _____%

2. Patent Ownership
A. owned intellectual property rights; B. shared intellectual property rights

1) How many patents were applied for?

2) How many patents have been authorized?
Invention: _____ New Utility: _____ New Design: _____

3) How many registered trademarks?

3. Have you obtained quality system certification? (For example, ISO9000 Certificate, ISO14000 Certificate or other certificates)

4. Over five years, the annual R & D input was as follows:
2007 _____ million, the proportion of turnover _____%
2008 _____ million, the proportion of turnover _____%
2009 _____ million, the proportion of turnover _____%
2010 _____ million, the proportion of turnover _____%
2011 _____ million, the proportion of turnover _____%

5. At the initial stage, the original investment and amount of percentage
1) entrepreneur's own savings: -----, ------%
2) bank loans: -----, ------%
3) investment by government or related organisations: -----, ---%
4) loaned from relatives and friends: -----, ------%
5) local society financing: -----, ------%
6) other channels: -----, ------%

6. Sources of finance for innovation activities:
1) enterprise self-financing:

2) bank loans:
3) equity finance:
4) domestic or international business associates, joint ventures or to attract foreign investment:
5) government innovation fund:
6) venture capital corporate finance:
7) others: (private financing, private loans, etc.):

7. Your company's core technology comes from:
1) purchasing patents and technology
2) M&A (mergers and acquisitions)
3) independent self-innovation: A. internal R&D; B. hired experts; C. introduction of special professionals
4) adapted technology and re-innovation: A. from other firms; B. from foreign technology
5) imitating innovation from advanced technology firms or competitors
6) joint development with other firms

8. Training at management level occurs: A. often; B. rarely; C. never; D. self-learning

9. Training courses for workers: A. regular specialised training; B. simple job training; C. systematic job training; D. no training

V. Network and external cooperation in the innovation process
1. Please tell us about ways your company has invested in and completed R & D projects in the recent years?

2. Product development or process innovation
1) Does the company cooperate with universities and research institutions locally or abroad? If yes, please list items. What kind of cooperation (long-term or short-term)?

2) Does the company collaborate with other companies local or abroad (suppliers, customer technology, or technology-leading firms) in stable, co-operative relationships? If yes, please list. What kinds of cooperation?

3) Does the company outsource to a professional advisory entity to carry out special research? If yes, please list items.

3. Please evaluate the cooperation between your company and other enterprises, universities and research institutions.

4. Which of your firm's following social relationships are closely related to your company's innovation?
1) customers or distributors
2) suppliers
3) other firms with advanced technology in the industry
4) competitors
5) other complementary firms or industries
6) relevant government departments
7) universities and research institutes
8) industry associations, professional consulting companies, etc.
9) other: _____

VI. The external environment for business innovation
1. What do you think about the current SME policy environment?

2. Do you know or understand the relevant Chinese SME support policies?
1) fully understand 2) partially understand 3) do not really understand

3. The role of national innovation policy and its impact on promoting Chinese SME innovation and development is:
1) very big 2) big 3) don't know 4) small 5) very small

4. In technological innovation, which sorts of supports has your organisation received from national or local governments (Multiple answers)?
1) Tax incentives

2) Government science and technology projects funding
3) National or local encouraging policies or regulations
4) External financial resources: A. grant funds; B. interest payments on loans; C. financial subsidies
5) Public technical service agencies or departments of service, including
A. Technical and scientific services
B. Career guidance
C. Business information and business management consulting
D. Finance advice and services
E. Entrepreneurs and personnel training
F. Intermediary services of technology transfer
G. Cooperative contacts
H. Intellectual property services
I. Building a technology industry cluster network platform
J. Policy advisory services

5. Of the support above, which really solved problems for your company in the innovation process?

6. From your point of view, what are the important internal factors impacting SME innovation?
1) entrepreneur's sense of innovation and strategic vision; 2) investment in business innovation decision-making at the management level; 3) R & D funding; 4) high-level employees of enterprises and employment mechanisms; 5) collaborations 6) corporate culture and innovation incentives; 7) enterprise learning and absorptive capacity

7. In your opinion of your company's practices, what are the four most important external factors that impact SME innovation?
1) market prospects for development and growth; 2) fair and competitive business environment; 3) government support (including policy support, financial support, tax incentives, etc.); 4) financial support policies and financing channels; 5) improving the public service platform; 6) industrial clusters; 7) protection of intellectual property rights and the establishment of a network system

VII. The company's future development strategy:

1.What are your company's next innovation goals and plans?

2. What are the main challenges that your company is facing now and in the future?

3. According to your point of view and experience, how does the firm plan to maintain its innovative edge?

Appendix B: Definition of Chinese Small and Medium Enterprises 2011

	Standard Small and Medium-sized Enterprises Provisions(table version)					
	Name of industry	Name of index	Unit	Medium-sized	Small-scale	Small
1	Industry	The number of employees	People	300-1000	20-300	<20
		Operating income	Ten thousand Yuan	2000-40000	300-2000	<300
2	Building industry	Operating income	Ten thousand Yuan	6000-80000	300-6000	<300
		Total assets	Ten thousand Yuan	5000-80000	300-5000	<300
3	Wholesale trade	The number of employees	People	20-200	5-20	<5
		Operating income	Ten thousand Yuan	5000-40000	1000-5000	<1000
4	Retail	The number of employees	People	50-300	10-15	<10
		Operating income	Ten thousand Yuan	500-20000	100-500	<100
5	Transportation industry	The number of employees	People	300-1000	20-300	<20
		Operating income	Ten thousand Yuan	3000-30000	200-3000	<200
6	Postal services	The number of employees	People	300-1000	20-300	<20
		Operating income	Ten thousand Yuan	2000-30000	100-2000	<100
7	Accommodation and catering industry	The number of employees	People	100-300	10-100	<10
		Operating income	Ten thousand Yuan	2000-10000	100-2000	<100
8	Agriculture, forestry, animal husbandry and fisheries	Operating income	Ten thousand Yuan	500-20000	50-500	<50
10	Warehousing	The number of employees	People	100-200	20-100	<20
		Operating income	Ten thousand Yuan	1000-30000	100-1000	<100
11	Real estate development and management	Total assets	One hundred million Yuan	0.5-1	0.2- 0.5	<0.2
		Operating income	One hundred million Yuan	0.1-20	0.01-0.1	<0.01

	Standard Small and Medium-sized Enterprises Provisions(table version)					
	Name of industry	Name of index	Unit	Medium-sized	Small-scale	Small
12	Information transmission industry	The number of employees	People	100-200	10-100	<10
		Operating income	One hundred million Yuan	0.1-10	0.01-0.1	<0.01
13	Software and IT services industry	The number of employees	People	100-300	10-100	<10
		Operating income	Ten thousand Yuan	1000-10000	50-1000	<50
14	Leasing and business services industry	The number of employees	People	100-300	10-100	<10
		Total assets	One hundred million Yuan	0.8-12	0.01-0.8	<0.01
15	Property management	The number of employees	People	300-1000	100-300	<100
		Operating income	Ten thousand Yuan	1000-5000	500-1000	<500
16	NES industry	The number of employees	People	100-300	10-100	<10

Appendix C: Detailed information about the interviewees

	Key informants	Department/position	Duration	Time	Remarks
Win-all Hi-tech Seed Co. Ltd					
1	Wenyan, Wan	Secretary	5 min	27.9.2011	
2	Yu Fan	R&D and Technology	131 min	28.9.2011	
3	Lu Xiao	Production, Quality Control	74 min	27.9.2011	
4	Yirei Liu	Sales Manager	95 min	28.9.2011	
5	Xiangzhou Jin	International Trade Manager	37min	30.9.2011	
6	Mancheng Zheng	Administration Director	40 min	30.9.2011	
7	Jungbao Jin	Marketing	134 min	27.9.2011	
8	Chengquang Li	Former Vice President/Technology Expert	75 min	18.1.2012	
9	Heiqing Wang	Production Manager	88 min	19.1.2012	
10	Qun Wang	Assistant Manager	108 min	19.1.2012	
11	Haiyin Zhang	Former President	33 min	1.20.2012	The total interview time was 2 hours. The last part of the interview was missing, but I wrote my field notes by recalling after the interview
12	Jinjie Cheng	Technology Director	168 min	12.3.2012	
Shanghai Xiwo Electrical Apparatus Co. Ltd					
1	Kui Zhang	Quality Control Manager	75 min	12.12.2011	
2	Yun Sun	President and Technology Director	182 min	12.12.2011	
3	Mr Wu	Production Director	91min	12.12.2011	

Hubei Changjiang Electric Co. Ltd					
1	Jijun Chen	Technology Manager	79 min	18.11.2011	
2	Mr Qio	Sales Team Leader	67min	17.11.2011	
3	Fei Zhang	Production Manager	71min	16.11.2011	
4	Quanjun Wang	Marketing Manager	105 min	21.11.2011	
5	Qui Zhang	Quality Manager	23 min	21,11.2011	
6	Mr Zhang	Purchasing Manager	8 min	17.11.2011	No memory space in my digital record, the rest is handwritten field notes.
7	Juan Wan	HR and Officer		17.11.2011	Filling in questionnaire and short interview with field notes.
Shanghai Huize Medical Instruments Co. Ltd					
1	Yunfei Wang	Assistant Manager	180 min	11.10.2011	
2	Mr Dai	Technology Manager	95 min	24.10.2011	
3	Mr Lin	Office Director	25 min	19.1.2012	
Shanghai Leo Laser Equipment Co. Ltd					
1	Mrs Zhu	Production Manager	103 min	22.2.2012	
2	Demin Wu	Technology Manager	107min	15.3.2012	
3	Mr Chen	Office Director	76 min	22.2.2012	
4	Hongbing Qian	CEO	74min	22.2.2012	
			60 min	15.3.2012	

Appendix D: The example of data interpreting and analysis

孙芸：西渥公司总裁兼技术总监

Sun Yun (President and Technology Director of Xiwo Company)

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工人原来星期六上班都是正常上班， 现在星期六上班两倍工资，之前我们是低成本的。 当时五年以前我公司 2 千万， 我公司是低成本的，利益是 10%的，几年前，我们能活下来是通过廉价的劳动力成本，但劳动力成本不再低廉，由于新劳动法在 2008 年 1 月颁布，工资水平上升变得更加昂贵。我们的劳动力成本增加了四个各种保险和周末双倍工资。近年来，现在新劳动法出台以后，现在午饭工作餐，我还要交四金，我们现在四金，以后 5 年还要涨，外地人与上海人待遇一样了。原来的综合保险 200 元，现在四金是 1500 元。四金 5 年以后要到 2000 多，加在一块。十年前工资只有 300 元。五年来， 我们的销售翻一倍。 人工成本现在很高。我们的利润已经由原材料和劳动力成本上升的挤压价格。因此，我们的公司有创新，以降低其他方面的成本。我们做产品附加值，所以在同一时间，我们必须确保产品的高品质。我们的产品质量一直比较稳定。

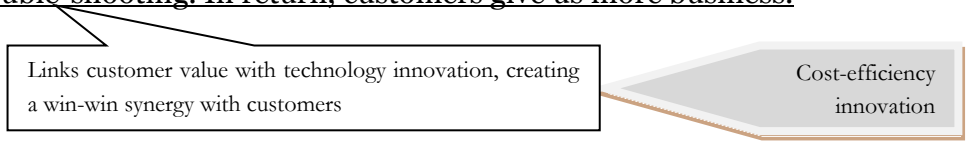
A couple of years ago, we survived by cutting costs through cheap labour, but labour costs are no longer cheap, since the new labour law promulgated in January 2008. The cost of workers became more expensive due to the wage levels going up. Our labour costs have added four kinds of insurance and double time pay on weekends. In recent years, our profit has been squeezed by the prices of raw materials and rising labour costs. Thus, our company has to innovate to reduce costs in other ways. We make value-added products, so at the same time we have to assure high product quality. The quality of our products has been very steady.

Minimising production costs and improving product quality

Cost-efficiency innovation

可靠的新客户还是不太好找，我基本上都是老客户。现在竞争很激烈。十几年以前温州 人还没进入行业，我们的客户还很稳定。例如，上海汽车电器总厂点烟器，给上海交通实业， 40 元， 现在我们点烟器因为温州人进入降低成本，降一半，现在都被他们拿走了。我公司对金属材料比较了解， 功能性的金属元件，双金材料都是我们做， 实通实业公司的喇叭模片，他们自己公司没有这种精度的设备，国营企业成本很高。所以都交给我们在做。我当时就给他们解总建议后，最几年出口北美。我公司对功能性材料比较熟悉， 是功能性金属材料专家。例如，铍 - 铜是一种被广泛使用于汽车部件韧性金属。铍和铜在加热时产生不同的熔融点。我们会给客户提供很好的建议在新产品开发方面，帮他们解决问题。客户提供技术支持，如故障排除。作为回报，客户给我们带来更多的生意。我们提供这种服务以后跟客户就非常默切，解决问题以后，这个零件也就给我们制造了。

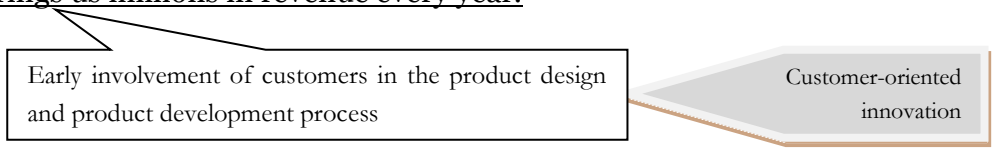
We are familiar with functional materials, experts in different sorts of functional metal materials. For example, beryllium-copper is a kind of ductile metal that is widely used in vehicle components. Beryllium and copper have different molten points that cause different forces when heated. We give useful technical suggestions to customers about their R&D or new product development, providing technological support, and trouble-shooting. In return, customers give us more business.



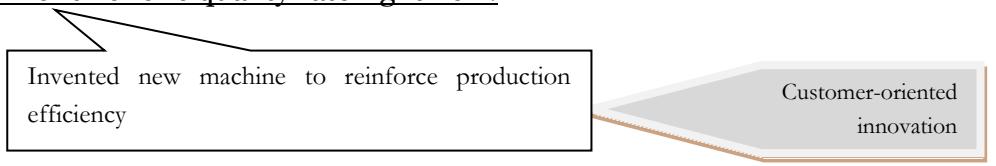
例如，该微动开关装置，我们为科世达 - 华阳公司生产和组装配件。我们现在负责设计和装配整体的一部分。从制造汽车零部件到汽车控制部件，这种进步帮助我们开拓新的领域。即使是现在，这款产品为我们带来数百万的收入。

For instance, this micro-switch device, we produced components for Kostal-Huayang Company to continuing assembly. We are now responsible for designing and assembling the whole part. From manufacturing auto components to auto control parts, this progress

helps us open up new and productive territory. Even now, this product brings us millions in revenue every year.

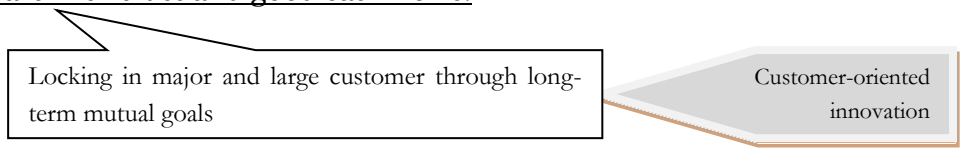


做汽车座椅的，江申制控电器厂。他们有难度大的，也是听人介绍的，他们就来找我们。那我们帮他生产成本低多了，从材料到电镀，象小糸车灯，他们有难的或急的，就来找西渥。在行业里，我们公司口碑很好。 我们要么不做，要做就做好，新产品的送样，我们合格率是很高的。 我们实力，设计和加工能力很强。 生存没问题，客户价格每年降，我们最大的客户，科世达华阳是德资企业，很大的 2 百亿欧，欧洲轿车开关是最大的，在国内轿车开关也是最大的。我们只生产零部件，没有生产成产品，我们帮客户做零部件。 我们现在四项微动开关 座椅，有八个银点，我们自己设计自己发明自动点焊机。 We designed and invented an automatic two-sided spot welding machine. 发明专利申请很长时间，设备是 2008 年申请的。 我们也申请国家创新基金了。 这个第一代设备制造得不好，合格率很低 10 万分之 30，第四代，现在可以达到百万分之一。The first generation of this machine didn't work well. The quality rate was 30 in a hundred thousand; the fourth generation can reach millionth of one quality rate right now.



同大客户建立关系以后， 我们经常向客户介绍我们能做什么，比如说流水线上的夹具（fixture），一点点让客户认识。我们现在以 30%速度增长。但是利润很少，每年在降价 3%-4%，没有讨价还价的。比如说，我们有两百个零件，一下降得话，新产品开发都来不及。哪些有开发那么快，我们做零件有那么大的量，真是很幸运的。我们没怎么做市场拓展。我们都找大企业，几家大客户十几年，大家讲信誉，资金方面良性循环。We didn't make efforts on market exploration so much; we are working for

large firms. Those companies we have been together for more than 10 years with trust and good cash flows.



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