MARK GREEVEN

Innovation in an Uncertain Institutional Environment

Private Software Entrepreneurs in Hangzhou, China

Innovation in an uncertain institutional environment: Private software entrepreneurs in Hangzhou, China

Innovation in an Uncertain Institutional Environment: Private software entrepreneurs in Hangzhou, China

Innovatie in een onzekere institutionele omgeving:
Private software ondernemers in Hangzhou, China

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For my family

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...and Ha Jin for inspiration

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Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Research problem

Recent studies on sectoral specialization and technological development have shown how distinct patterns of technological development and innovation can be explained by different institutional arrangements (Hall and Soskice, 2001; Aoki, 2001; Whitley, 1999, 2002). This research focuses on a selection of the world's economies, e.g. Europe and USA. The fast developing and successfully emerging former socialist economies of Eastern Europe and East-Asia – transition economies – are qualitatively different from the relatively stable, developed market economies. Whereas Western European and US economies generally provide a stable institutional frame that constrains opportunism, reduces uncertainty, manages conflict and cooperation, provides incentives and mobilizes resources (Coriat and Weinstein, 2002; Edquist, 1997; Crouch, Le Gales, Trigilia and Voelzkow, 2004), former socialist economies undergo institutional transition that fundamentally changes the key economic agents[1], commitments, resources and constraints on opportunism (Peng, 2003).

An example of institutional transition is the transformation of 1989-1990 in Eastern Europe. It has abolished the previous rules governing economic action, but new rules have not yet taken their place (Peng, 2003). In particular, these economies have a legacy of state socialism that is still ingrained in current institutions while a general distrust of new institutions inhibits the regulation of (market) relationships between economic agents (Roth and Kostova, 2003; Peng, 2003; Stark, 2001). Moreover, the absence of intermediary organizations that are able to mobilize commitments and resources between individuals, business and the state hinders economic activity (Czaban and Whitley, 2000). Generally, it is unclear who the economic agents are, what their interests are and what kind of resources they mobilize. As such, businesses in transition economies faces increased uncertainty, opportunism and higher search costs for resources and have reduced incentives for anything more than survival, such as innovation.

A different picture is seen in China, the largest and economically most successful transition economy. Businesses in the IT sectors in the coastal regions of China show innovative behaviour of a non-trivial kind[2]. While indigenous computer companies

[1] Economic agents can be individuals, business and the state (departments, ministries, agencies, etc.)

[2] Innovation that is both systematic and successfully enhancing the competitive position of companies

such as Lenovo and Founder emerged from the state sector, a host of private entrepreneurial activities in the software sectors led to the development of new private firms like Alibaba, Baidu, Sunyard and AsiaINFO. These innovative businesses are being integrated in international value chains, sometimes stock-listed on NASDAQ (e.g. AsiaINFO), attract foreign capital and successfully develop and commercialize new products and services (Zhou, 2008; White, Gao and Zhang, 2002; Lu, 2000; Gu, 1999). Moreover, Sino-foreign research and development collaborations are being established to perform increasingly complex research activities in IT sectors, which indicates the advanced level of capabilities of Chinese IT companies (Liang, 2004; Walsh, 2003; OECD, 2007).

The question arises why domestic Chinese entrepreneurs were not only able to survive but also to innovate while facing constraints from institutional transition. How can these firms constrain opportunistic behaviour and make credible commitments to innovation? How are search costs for labour and capital lowered? More precisely, this thesis addresses the following main question: *What kind of capabilities for innovation did domestic private entrepreneurs develop in China's uncertain transition economy?*

1.2 Innovation in China: emerging private IT industries

China is becoming increasingly innovative in particular sectors and regions. Interesting examples of recent Chinese break-through innovations are an electronic publishing system for pictographic languages, a new 3G mobile telecommunications standard (TD-SCDMA) and a new anti-malaria drug. At a more systematic level, China started to overtake Europe with respect to the number of new patent applications filed (China Statistical Yearbook on Science and Technology, 2004). Interestingly, the ratio of patent applications by enterprises increased to 62% in 2003 (from 30% in 1985), suggesting an upgrade of enterprise capabilities compared to universities, R&D institutes and government agencies. Furthermore, China is no longer only the world's production facility for low-tech products, on the contrary, high-tech exports increased from 5% of GDP in 1990 to 30% in 2005 (OECD, 2007). The composition of exports is more sophisticated than that of countries with similar GDP per capita. However, the most telling evidence for China's increased innovative capabilities is perhaps the recent surge of European R&D involvement in China with Chinese partners (Wu and Callahan, 2005; Yuan, 2007; Zhou and Xin, 2003).

Innovation takes place in particular sectors of China's economy. The IT sectors draw our attention with respect to overall success and innovation. The IT industries are among the fastest growing industries, surpassing some traditional industries such as oil and steel (Liang, 2004). Over the period 1997-2002, the computer hardware sector had an average annual growth rate in gross industrial output value (current prices) of almost 35%. In the same period, the software sector grew with a steady 30 % (China

Statistics Yearbook on Science and Technology, 2004). The growth of gross industrial output value in high-tech sectors including the IT sectors is 20%, excluding these sectors only 12%, suggesting a relatively fast growth of the IT sectors compared to other high-tech sectors (1997-2002).

OECD and China Statistical Bureau data show that the IT sectors have the highest input and output of R&D – as the only available measures of innovation performance – of the high-tech sectors. For instance, computer sectors have the highest R&D intensity of all high-tech sectors and the import and export of IT goods is by far the largest (OECD, 2007). Beyond the statistics, examples of successful IT innovators can be found in Batjargal's (2007) study of innovative software ventures in Beijing and Lau, Lu, Makino, Chen and Yeh's (2004) investigation of large, successful high-tech firms. Furthermore, Qiwen Lu and William Lazonick's studies of innovation in the computer hardware industry (e.g. Lu, 2000; Lu and Lazonick, 2001) and Shulin Gu's work on New Technology Enterprises in the IT sectors (Gu, 1996).

Innovation in the IT sectors mostly takes place in the coastal regions of China. The geographic distribution of firms in the IT industry over China is unequal: most of the best performing firms in the industry are located in the Yangtze River Delta, the Pearl River Delta; the Bohai Sea Rim and areas along the Shenyang - Dalian expressway (OECD, 2007). Beijing, Shanghai, Shenzhen and Xian are the country's four best-known high-tech cities. Of these, Beijing has by far the largest high-tech area with approximately 8,000 enterprises and 280,000 employees generating 17 % of all high-tech enterprises' gross output value and 13 % of all high-tech exports in 2002. Moreover, China Statistical Yearbook on Science and Technology (2004) data suggest that 60% of total R&D expenditures are found in the six coastal provinces.

Innovation is increasingly observed in domestic private enterprises. According to the OECD (2007), the main agents of innovation are domestic enterprises. Lu (2000) and Zhou (2008) provide further case-evidence of this observation and OECD statistics show that the R&D intensity in domestic IT firms is much higher than in foreign IT firms that operate in China. Research suggests that it is especially small private high tech firms that become increasingly innovative (OECD, 2007; Zhou, 2008; Von Zedtwitz, 2004; Tan, 2005). These small firms tend to form innovative networks, mostly in Zhejiang, Jiangsu and Guangdong, provinces which are well known for their entrepreneurial accomplishments and success of IT sectors (Tan, 2005). **Exhibit 1.1**[3] provides an illustration of a domestic private software entrepreneur in Hangzhou, the capital of the coastal Zhejiang province. To put these developments in perspective, I will briefly discuss the emergence of IT sectors amidst institutional transformation.

[3] Based on http://www.ferrygame.com/

Exhibit 1.1 Dressed in a Western suit, laughing out loud, Jin Jin has a rather young appearance, exactly that of a university student. However, this 23 year old graduate student from China is also the CEO of Hangzhou-based Ferry Network Company, a successful 3D online gaming company. Established only in April 2005, the company now has a market value of one billion RMB ($120 million), attracted foreign venture capital in 2007 and employs 300 employees. Jin Jin turned the company in only 2 years time into the biggest online game company in Zhejiang Province, one of the most wealthy and entrepreneurial regions of China.

Originally from Jiaxing – neighbouring Hangzhou – and destined to follow in his father's footsteps in the traditional family business, he trusted his own vision and decided to jump onto the second wave of investments in network gaming in 2005. Travelling between Jiaxing and Hangzhou, he often saw the advertisements of the Overseas Chinese Entrepreneurship Park. At that time, his brother was studying abroad and after Jin Jin saw the ad, he wanted to help his brother. However, instead of his brother, Jin Jin grabbed the opportunities in Hangzhou and started for himself. Knowing the local market environment and being personally involved with gaming, he developed a new online 3D gaming environment. With his own initial investment of about 5,000 RMB and self-made equipment he managed to earn one million RMB in only 3 months. After the early profits, his parents provided the next millions, seeing the low risks, low costs and maintenance of high-tech investments compared to the investments in traditional industries. Two years later foreign capital boosted the market value to one billion RMB.

Hangzhou's business environment played a significant role in boosting new high-tech industries, such as the animation game business. The available talent pool, the high status Zhejiang University and local preferential policies for young entrepreneurs promoted and facilitated the development of new industries. Jin Jin initially got free office space from the High and New Technology District. Furthermore, the District's director helped to overcome recruitment problems and provide logistic support. Furthermore, people like Ma Yun (43, CEO of Alibaba) and Chen Tianqiao (32, CEO of Shanda Interactive Entertainment) set an example for entrepreneurs like Jin Jin.

1.3 Emergence of IT sectors amidst institutional transformation

How did the IT sectors emerge and in what context? The initial commitment to reform China's socialist economy involved an incremental reform of the central plan and the introduction of a market system. The government was reformed through regional decentralization and non-state enterprises emerged. Since the mid-1990s a significant private sector has emerged in China (Asian Development Bank, 2006; OECD, 2007; Krug and Hendrischke, 2007; Tsui, Bian and Cheng, 2006). Instead of mass privatization, China's private enterprises emerged 'from below', initially via the

township-village enterprises in the rural areas in the 1980s. At the end of the 1990s the private sector already accounted for over 40% of GDP. Reforms and ideological shifts in the 1990s, such as the Company Law in 1993 and the Sole Proprietorship Enterprise Law in 1999, paved the way for private entrepreneurship. Especially entrepreneurship in specific sectors was promoted and this facilitated the development of new technology enterprises (NTEs) (Gu, 1999) in IT sectors (Lu, 2000; White, Gao, and Zhang, 2002). At the same time, emerging high-tech entrepreneurship put enterprises at the centre of an emerging innovation system that focused on commercializing newly developed technologies (Gu, 1999; Liu and White, 2001; OECD, 2007).

In addition to the emergence of private entrepreneurship, the development of IT sectors was facilitated by state intervention of a special kind. Usually state intervention in a state socialist economy refers to regulation, taxation or resource control, all of which serve the purpose to either set hard (budget or regulatory) constraints or formulate negative incentives. In the case of the IT sectors, state intervention refers to the opposite: deregulation of the sector, liberalisation or positive incentives in the form of tax exemptions, if not subsidisations of firms or activities. Starting in the 1980s, the state promoted collaboration between public research, the state's science and technology (S&T) system and enterprises. Initially, most of the resources went to state-owned institutes rather than the potentially more innovative non-governmental enterprises (Saxenian and Quan, 2005) and not many new products were brought to market. Since the mid-1990s, the focus shifted to upgrading the innovative capabilities of enterprises. However, as opposed to public procurement policies, which were crucial for the success of IT sectors in for instance the USA, there have been policies at arm's length. For instance, the 973 program (1997), the Innovation Fund for Technology-based SMEs (1999) and recognition of private ownership (1999), focused on enhancing firms' innovation capabilities and commercialization of public research and to put the firms more in the centre of attention (OECD, 2007). It is in this context that the IT sectors emerged. this thesis will focus on hardware and software sectors as the most interesting IT sectors.

In the 1980s, the Chinese computer market basically only existed in Taiwan and mainland computer hardware firms mostly assembled imported kits and low-tech electronics production. After increased international competition in the 1990s, the Taiwanese computer firms moved operations to mainland China. Throughout the 1990s, Taiwan and Hong Kong were responsible for a large part of the investments made in the coastal regions. The involvement of Hong Kong and Taiwanese firms enhanced the technology level and management skills (Lu, 2000; Kreamer and Dedrick, 2001). The inflow of foreign capital and technologies from Japan and USA in the late 1990s, returned overseas Chinese engineers (Saxenian, 2006) and intensive state promotion of high-tech development boosted the performance and innovativeness

of the computer hardware firms such as Lenovo and Stone. According to Lu (2000) these successful domestic computer enterprises followed a unique top-down mode of technology learning: these firms developed integrated capabilities on the basis of the indigenous Science & Technology (S&T) capabilities accumulated during the central planning period. Moreover, these enterprises were neither state- nor privately-owned but have a collective/public organizational form that allowed extensive managerial autonomy, technological learning from foreign joint-ventures and access to state S&T resources ('hidden subsidies'). In sum, innovation in the computer hardware sectors was facilitated by state support and foreign investment.

The development of the Chinese software sectors is based on different basis. The sectors started to develop only in the 1990s without links to the state's resources and focused on developing Chinese language software serving a growing domestic market. The market is skewed with a handful of foreign firms dominating 60% of the market, while the rest is left to domestic small private firms. The domestic market is expanding rapidly: from 1992 to 2000 with an average annual growth rate of over 30% (Saxenian and Quan, 2005; Tschang and Xue, 2005). The global Internet hype of 2000, active support from the government, and above all the private domestic and foreign entrepreneurs brought financial and knowledge resources to the software industry (Tschang and Xue, 2005; IFC, 2005). Especially, the Internet software market has developed very fast after 2004 and has produced innovative market leaders such as Alibaba, Baidu and Tudou.com that outcompete eBay, Google and YouTube in the Chinese market (Tai, 2006). We also see Sunyard in the enterprise resource planning software (ERP) market that developed an optical character recognition system for Chinese characters on the basis of state-of-the-art university research. These recent cases suggest the innovative potential of Chinese software firms.

Without a link to state S&T resources nor foreign technologies and capital, software firms need to find new ways for doing business, new ideas for re-combining productive factors, developing and producing new products or more efficient production technologies in order to not only compete with resource-richer SOEs, and foreign firms, but also for coping with (in)direct political constraints and limitations in resources (Batjargal, 2007; Krug and Polos, 2004; Tylecote and Visintin, 2008; Xin and Pearce, 1996). In this context, it is surprising that private software firms can be innovative. There are few studies on the Chinese software sector, mostly because the software sectors are still considered to be the weakest link in IT (e.g. Brizendine, 2002). However, the growth rates, case evidence and the few studies on software sectors (e.g. Batjargal, 2007; Tai, 2006; Saxenian and Quan, 2005; Tschang and Xue, 2005; IFC, 2005) suggest that the software sectors are innovative, driven by private firms, government support policies and are becoming a domestic business with substantial growth prospects.

This study focuses on private sector driven innovation in China's software sectors. In what follows we will develop a working theory to analyze how and what sorts of capability for innovation are developed in response to what kinds of restrictions.

1.4 Key concepts

Innovation in the context of firms is the ability to create economic value from new business models, products, processes, markets and value chains (Schumpeter, 1934).

In this study we distinguish incremental from radical innovation because the type of innovation will influence the type of capabilities necessary: incremental innovation involves refining, improving, and exploiting an existing technological trajectory, whereas radical innovation involves disrupting an existing technological trajectory.

A second important feature of innovation is the extent to which an innovation is systemic, modular or stand-alone (Nooteboom, 2004) because the extent to which an innovation can be developed in isolation influences the required capabilities. A systemic innovation has high switching costs and limited exploration of new activities since the different elements of the product or service system are interconnected ('interface'). In contrast, a modular innovation knows standards on interfaces yet allows flexibility and thus has lower switching costs. A stand-alone innovation is characterised by autonomy of elements and limited constraints on interfaces resulting in low switching costs and extensive exploration possibilities.

Institutions legitimate, guide and constrain the coordination of various economic actors and the way they solve economic problems in terms of the nature of ownership relations, inter-firm connections and governing access to critical resources such as labour and capital (Hollingsworth and Boyer, 1997; Whitley, 1999).

Critical resources refer to tangible and intangible firm-specific assets that are available for the firm to own, control and use at the exclusive discretion of the firm (Amit and Schoemaker, 1993; Teece, Pisano and Shuen, 1997; Nooteboom, 2004). Idiosyncrasies in resources, routines, identities and conceptions form the basis of specific capabilities of a firm (Buenstorf and Murmann, 2005).

Innovative capability in this thesis is defined as the firm's ability to integrate, build and reconfigure internal and external resources to develop and successfully commercialize new products and services (Chapter 3 will elaborate these key concepts). The next section focuses on developing a working theory of innovative capability development.

1.5 Innovative capabilities: A working theory

What sorts of capabilities are necessary to develop in response to what kinds of restrictions of an uncertain institutional environment? We will argue that a combination of resource-based perspectives and institutional perspectives on

capability development is necessary to find an answer to this question in the empirical study. In what follows we argue that innovative capability development depends on:

- the critical resource base directly or indirectly available,
- the nature of the innovative activity pursued in the sector (sector specificity),
- the institutions in the business environment (institutional specificity).

A working theory for explaining the development of innovative capabilities should take into account the technological and institutional conditions of a transition economy. The connecting factor here is 'critical resources'. Capability development for innovation depends on the set of critical resources necessary for innovation while technological conditions affect the *requirements* of capabilities and institutional conditions affect the *availability* and *use* of critical resources[4].

First, the development of capabilities centres on the use, distribution, allocation and governance of critical resources. Critical resources are key factors to explain organizational form, behaviour and performance that form the basis of (dynamic) capabilities to innovate (Teece, Pisano and Shuen, 1997) to learn (Fiol and Lyles, 1984) and to evolve (Kogut and Zander, 1992). A capability, in its broadest interpretation, enables a firm to grow and take advantage of its opportunities while fighting off restrictions (Penrose, 1995; Wernerfelt, 1984). Whereas early resource- and competence based studies focused on relatively static and stable sources for competences, these ideas have recently being extended to explore the dynamics of how firms gain and loose competitive advantages (Teece, Pisano, and Shuen, 1997). Current work suggests that idiosyncrasies in resources, routines, identities and conceptions form the basis of specific capabilities of a firm[5], whether capabilities are originating inside or outside the firm or are static or dynamic in nature (Buenstorf and Murmann, 2005). Teece et al's (1997) dynamic capabilities concept is useful here because it addresses dynamics and change and stresses the organizational nature of competitive advantages: 'the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environment' (p. 516). We adopt most of this definition and apply it to the specific context by focusing on innovation and critical resources. Innovative capabilities reflect *the firm's ability to integrate, build and reconfigure internal and external critical resources to develop and successfully commercialize new products and services.*

[4] We do not take deterministic view of either institutional or technological regimes (Chapters 2, 3)

[5] A review of the literature and definitions of competences and capabilities is presented in Chapter 3.

Second, sectoral characteristics affect the development of innovative capabilities. The sectoral approaches to innovation show that sectors with distinct technologies have different innovation patterns. Sectors can be differentiated according to their specific technical and market risks, or technological regimes (TRs) (e.g. Malerba and Orsenigo, 1993; Dosi, 1988; Parker & Tamaschke, 2005). Technological regimes are comprised of opportunity and appropriability conditions in addition to characteristics of the knowledge base and degree of cumulativeness. These characteristics of technological regimes and their knowledge base provide restrictions on firms' learning, capabilities and organization and coordination of innovative activities in a sectoral system. Different sectors then have different patterns of innovative activities. However, innovation leads to economic change only to the extent that agents are successful in taking advantage of the opportunities, i.e. agents need to develop capabilities (Carlsson and Stankiewicz, 1991). Those capabilities will differ strongly across technological regimes that characterize sectors (Casper and Soskice 2004).

The link between technological regimes and capabilities has been studied in case studies and statistical exercises. Several statistical studies reveal patterns of innovative activities linked to specific technological regimes (e.g. Malerba and Orsenigo, 2000). Case study examples of this result are for instance Henderson and Cockburn (1994) and Iansiti and Clark (1994) in pharmaceuticals, computers and automobiles in which capabilities differ across sectors. The most recent study linking characteristics of technological regimes to innovative competence development is Casper and Whitley (2004). Generally, research suggests that contrasting patterns of innovation can be explained by sectors with different technological risks (Malerba, 2004). Therefore, *we expect that the characteristics of a technological regime influence the required innovative capabilities by demanding specific types and amounts of critical resources.*

Beyond sectoral constraints, firms face institutional constraints that shape and guide capabilities. The sectoral approach to innovation does not downplay the role of institutions (see Malerba, 2004) but is generally weak in explaining which capabilities are developed under precisely what institutional conditions. How institutional conditions affect innovative capabilities is a question to which we turn now.

Third, institutions may either constrain or facilitate innovativeness (Hage and Hollingsworth, 2000; Edquist, 1997). For instance, studies on the market economies of the US and Europe has shown how distinct patterns of technological development can be explained by the different institutional arrangements of various kinds of economies (Hall and Soskice, 2001; Aoki, 2001; Whitley, 1999, 2002). These studies explain that *institutional regimes* affect the dominant logic underlying decision making in organizations. On the one hand, they have distinct patterns of resource distribution and influence how firms have differential access to critical resources, such as knowledge

about new technologies and markets, availability of skilled workers of different kinds, and access to capital (Coriat and Weinstein, 2002; Whitley, 2007). On the other hand, institutional regimes specify, monitor and control the powers and responsibilities of private companies, especially their authority and discretion. Institutional rules and constraints vary considerably across societies as for instance, state regulation; education systems and extent of unionisation vary considerably across societies and over time and influence competitive behaviour of firms – especially the development of innovative capabilities (Whitley, 2007). In short, institutional arrangements affect the pattern of resources and constraints on their use. Therefore*, we expect that institutional regimes influence the development of innovative capabilities by 1) distributing and allocating access to critical resources and 2) constraining the opportunistic use of these critical resources.*

We cannot directly extend these ideas developed in relatively stable, developed market economies into China's transitional economy. The institutional framework in China has two distinct features that influence the way how capabilities are developed: institutional uncertainty (unpredictable and incomplete institutions) and variety of local institutional systems. First, China has weak economic institutions. The institutions are not weak because they have a socialist hue, which is traditionally unsupportive of private capitalists, but because institutions inherited from both the socialist era and market-oriented institutions co-exist (Krug and Polos, 2004). Institutions are incomplete and unpredictable in the sense that they do not provide a stable institutional frame (Qian, 2000), which would reduce the uncertainty emanating from innovation (Krug and Polos, 2004). Weaker institutions allow greater variety of organizational responses and thus a higher uncertainty of outcomes. Therefore, it is uncertain which kind of capabilities and strategies are credibly developed.

Second, China has a variety of local institutional systems. The heterogeneity of China's local business environment is a consequence of China's decentralized government system. Such local variety leads to vertical intergovernmental inconsistencies where local governments do not or only partly implement central policy. Furthermore, it leads to horizontal competition between local governments (Krug and Hendrischke, 2008). However, such local business practices coexist with the integration of markets, coherence in political institutions and conformity in behaviour (Krug and Hendrischke, 2008). So, in contrast to most comparative institutional studies, which take the nation state as the boundaries of analysis, China's economy is characterised by a *diversity* of local business environments at the sub-national level asking for a local perspective. Therefore*, we expect that a changing institutional regime will affect the distribution and governance of access to critical resources by 1) increasing uncertainty and 2) increasing local diversity*.

To understand the connections between capabilities, institutions and technological conditions, we need to connect the institutional level to the firm level. However, the link to the firm level remains an issue in most analyses (Hage, 2003; Whitley, 2006). Only few studies directly analyse this link: the conceptual work of Whitley (2003) and Hage (2003), and the empirical work on Italian textile districts (Locke, 1995) and European biotechnology (Casper and Murray, 2003), career networks of biotechnology clusters (Casper and Murray, 2005) and software and biotechnology sectors in Germany and the UK (Casper and Whitley, 2004). Contrasting patterns of innovation can be explained by comparing varieties in institutional frameworks across countries and across sectors where technological risks differ (see in particular Casper and Whitley, 2004). In short, the connections between institutions, technologies and capabilities are crucial for understanding capability development.

1.6 Research questions and goals

The main research problem address in this thesis is: What kind of innovative capabilities did domestic private entrepreneurs develop in China's uncertain transition economy? The following sub questions are formulated: First, how do institutions govern and coordinate access and distribution of critical resources for innovation in the software sectors at the local level? Second, what kind of innovative behavior do Chinese software entrepreneurs show? Third, what kind of sectoral and institutional constraints influence the development of innovative capabilities by Chinese software entrepreneurs? Fourth, what kind of innovative capabilities are developed by Chinese software entrepreneurs in response to sectoral and institutional constraints?

The thesis then has the following intellectual goals. The study aims to *set the institutional frame* by analysing the features of the key institutions that govern and coordinate access and distribution of critical resources for the software sectors. The study needs to identify the consequences of dismantling the state socialist economy, i.e. institutional transition, at the local level. The analysis sets the institutional frame for the investigation of innovative behaviour at the firm level. The core of the study aims to analyse *the underlying firm-level mechanisms* that explain the development of innovative capabilities of Chinese private entrepreneurs to fight off sectoral and institutional constraints. The goals are threefold: (1) identify and analyse patterns of innovative behaviour of Chinese private firms; (2) identify and analyse patterns of sectoral – and institutional constraints on innovation and (3) identify and analyse patterns of innovative capabilities in response to those constraints.

1.7 Research strategy

The nature of the research problem and the working theory set four challenges for the design of an appropriate research strategy:

1. To take into account and reconcile institutional and firm levels of analysis;
2. To identify new organizational forms in newly emerging industries;
3. To embark on a comparative study of specific features of sectors and their consequences for innovation by private entrepreneurs;
4. To take a local perspective that takes into account the specific local conditions and development patterns that influence local patterns of organizing and coordinating economic activities.

These challenges necessitate a qualitative, inductive research approach. Qualitative research refers to the in-depth study of social phenomena in their context, focusing on questions of how and why. Inductive research refers to developing general principles from specific observations (cf. Uzzi, 1997, Eisenhardt, 1989, Verona and Ravasi, 2003). The under-theorized connection between the micro-level (firm's capabilities) and macro-level (institutions) necessitate an inductive research method as opposed to testing deductively derived hypotheses (Hage, 2003; Whitley, 2006). The purpose of the research is to pursue substantive explanatory issues via a detailed empirical study to understand how socio-economic mechanisms account for significant phenomena (Whitley, 2006). It is productive to study socio-economic mechanisms and their particular outcomes in relation to the specific conditions under which they operate. Context-specificity does not refer to mysterious residuals or inconvenient noise but is the basis for complex multivariate theorizing (Child, 2000). As opposed to testing sets of variables and their relations in isolation from these conditions, this thesis will rely on systematic explanations of how combinations of causal processes produce distinct patterns of economic organization and coordination.

It is worth emphasising that socio-economic actors are constituted differently in different socio-economic contexts, in which capabilities and interests differ (Sorge, 2006). Therefore, the nature of institutions, firms and their capabilities differ significantly across socio-economic contexts. Even though we identified two distinct levels of analysis – institutional - and firm level – it is premature to assume that they are constituted in the same way in China as in other economies. For instance, the firm as a legal entity in China is certainly not the only collective actor that pursues economic goals. A variety of organizational forms exist beyond the legally defined firm (e.g. Krug and Hendrischke, 2007). Considering these issues, a qualitative, inductive approach to the study of capabilities and institutions in China's context is warranted (chapter 5 elaborates on the methods and techniques).

Innovation takes place in particular sectors and we will focus on the sectors that are most interesting for innovation studies, the software sectors, because they are completely newly emerging. These sectors are emerging successfully, are surprisingly innovative, dominated by private firms and interesting for innovation studies as China's environment poses a variety of restrictions (such as intense competition and high search costs for capital and labour), i.e. unlikely to facilitate innovative behaviour. In contrast to the computer hardware sector, innovation in software sectors is private sector-driven without strong state - or foreign support (section 1.3). Software sectors are unusual as they show both radical as well as incremental processes of innovation with various kinds of technical and market risks (Steinmueller, 2004; Casper and Whitley, 2004; Ibert, 2004). As proposed in the working theory, we cannot assume that innovative activities are similar across sectors with distinct technological and market characteristics. A comparative study of distinct sectors is necessary to identify capability development for distinct innovation processes.

The selection of distinct software sectors, then, is motivated by a) the type of software development, i.e. what are the most significant types of software development and – markets; b) the expected dominant innovation pattern in different sectors and c) benchmarking other studies of software sectors (e.g. Casper & Whitley, 2004; Ibert, 2004; Kogut, 2004; Mowery & Nelson, 1999). Three sectors are selected for comparative study: Standard application based software (stand-alone, radical innovation), middleware (modular, radical innovation) and enterprise software (systemic, incremental innovation). On the one hand, these three sectors represent the three main software sectors in terms of type of software development (Steinmueller, 2004). On the other hand, they represent sectors with distinct innovation patterns. This allows us to analyse and understand innovative capability development in the most important software sectors and at the same time across different types of innovation. Considering the importance of the sectoral perspective, Chapter 2 will elaborate on these software sectors within the Chinese business environment.

Choosing a location for the research implies selecting an institutional frame. Hangzhou has been selected as the location for the empirical study. The 'population' is a variety of localities. The selection is driven by the intensive data collection efforts necessary for getting familiar with the local context in terms of language, local culture and the development of research networks and connections with business enterprises. We used four criteria to select Hangzhou as a research location: the presence of a successful indigenous software industry; private firm as a dominant form of economic coordination and organization; the success of the locality in terms of economic prosperity; and the presence of all three software sectors. Considering the importance of selecting this research setting, Chapter 4 will elaborate on Hangzhou.

This thesis presents a detailed empirical study of private software firms in Hangzhou. The sample consists of 45 software enterprises in three distinct software sectors with an average firm age of 5.8 years (1995-2006), on average 75 employees (6-260) and between 200.000 (Internet software) and 80 million RMB (large scale ERP project for government). Enterprise software firms develop extensively customized software using platforms or modules. On average these firms are 6.6 years old (1995-2006) and employ 73 employees (6-200). Standard application based software firms develop software applications for large homogenous markets. These firms are on average 5.6 years old (1996-2006) and employ 46 people (28-100). Middleware firms focus on developing interface technologies that link basic architecture of digital communication networks to standard application software. These firms are on average the youngest with 5.4 years (1995-2006) and employ on average the most people, 95 (8-260).

Data were gathered mainly through fieldwork in China. It consists of two extensive fieldtrips between 2005 and 2007. The initial fieldtrip was between August 2005 and August 2006. During this year the author accumulated Chinese language skills by studying at Zhejiang University that proved to be crucial not only to do fieldwork interviews but also to develop trust with (potential) interview partners, academic partners and assistants and get familiar with the local research context. The second goal was to build an extensive research network. This network involved around 90 IT professionals, entrepreneurs and managers at small software firms but also at telecom firms, computer hardware firms and industry associations. The development of the network involved a range of social activities, friend-of-friend introductions and regular visits at conferences. Moreover, the research network consisted of two full professors of Zhejiang University, two assistant professors, a group of PhD students in the field of innovation management and two research teams of graduate students.

During the first half of the first year we developed the research instruments, trained the assistants and did interviews with local IT industry players. The second half of the year we did the first round of interview with software entrepreneurs. The second fieldtrip took place between April and December 2007. The main goals were to do additional interviews with other entrepreneurs in order to reach saturation and create a large enough sample, to establish communicative validity by revisiting several enterprises and communicate and discuss initial results with local Chinese professors. The constant dialogue between the Chinese entrepreneurs, Chinese professors and our research group proved crucial for developing the ideas presented in this thesis.

The thesis relies on two data sets: in-depth interview data of 45 Chinese software ventures and archival data, statistics, including company websites, industry news and publications to complement and triangulate data sources. Furthermore, return visits to

a selection of 11 firms allowed us to present and communicate some of our initial ideas and gather additional data to strengthen and refine the emerging ideas. Chapter 6 makes use of data about various economic and institutional actors, historical explanations, field data and reconstructs the institutional arrangements that govern economic activities in Hangzhou. Chapters 7, 8 and 9 use comparative case analysis, which enables a replication logic in which cases are a series of experiments that allow (dis)confirmation of inferences drawn from the others. Chapter 9 uses inductive analysis of the in-depth interview data with entrepreneurs, which aims at building on and moving beyond the informants' descriptions in an attempt to interpret facts and information and integrate them in an emerging theoretical framework. Chapter 5 presents a detailed description of the research techniques.

1.8 Contributions

The key contribution of this thesis is in the field of innovation management. One of the key insights is that *innovation is possible in an environment with institutional uncertainty and limited protection of property rights because, on the one hand, institutional uncertainty creates both restrictions and incentives for innovation, and, on the other hand, firms are able to develop specific innovative capabilities that manage sectoral constraints while fighting off institutional constraints.* Conceptually this suggests that an explanation of innovation should combine insights from capability theories with institutional analysis and sectoral studies of innovation.

There is a set of related contributions in this study. This study provides insights into the firm-level mechanisms of innovation in China's emerging private business sector. Research on innovation in China usually stays at the national level (e.g. Liu and Buck, 2007; OECD, 2007), explaining developments in innovation systems (Liu and White, 2001) and analyzing latecomer strategies and technological catching-up (Li, Kozhikode, 2008). Other studies focus on specific features of innovation development, such as the study by Batjargal (2007) of social capital in innovative software ventures in Beijing or knowledge management in large, successful high-tech firms (Lau, Lu, Makino, Chen and Yeh, 2004). Firm level explanations of innovation mechanisms are limited to a handful of researchers, most prominently Lu and Lazonick who studied the computer hardware industry (e.g. Lu, 2000; Lu and Lazonick, 2001) and Shulin Gu who studied New Technology Enterprises (Gu, 1996). None of these studies explore and/or explain innovation mechanisms at the firm level in China's emerging private sector. This study specifically extend Lu's (2000) study of indigenous innovation. Whereas Lu focused on non-governmental computer firms with a collective/public nature that allowed extensive managerial autonomy and access to state S&T resources, this study explores innovation processes of private firms that emerged since the 1990s without a state's socialist legacy.

Furthermore, the study provides insights into the development of innovative capabilities in China's emerging private business sector by acknowledging institutional constraints. The combination of capability (resource)-based and institutional perspectives promises valuable insights because it emphasises the organizational nature of competitive advantages and the role of management in mobilizing and transforming human and material resources (Teece, Pisano and Shuen, 1997), while acknowledging institutional forces which influence the way firms manage their resources and determine the value of their resources (Priem and Butler, 2001; Whitley, 2002; Lazonick, 2007). Especially in transition economies we cannot isolate the resource based perspective of firms from changes in the environment to which firms need to quickly and flexibly respond (Meyer and Peng, 2005; Wan, 2005).

This study extends the focus of these comparative institutional studies into transition economies. That institutional arrangements in transition economies are substantially different from those in developed economies (Aoki, 2001; Khanna and Palepu, 1997, 2000; Whitley, 1999) is well known. In the case of China or any other transition economy, we observe frequent institutional change and diversity of ;local institutional arrangements (Qian, 2000; Nee, 1992; Krug and Hendrischke, 2008). In short, this study incorporates institutional change and local diversity in the analysis of innovative capabilities.

1.9 Outline thesis

The thesis is organized as follows. Chapter 2 takes a sectoral perspective and discuss China's emerging software sectors and the provision of critical resources to these sectors. Chapter 3 will further develop the working theory by looking at innovation, capabilities and institutions in order to provide a guide for the empirical study. Chapter 4 discusses the location of the study, Hangzhou and her key features. Chapter 5 describes the research methods and techniques. Chapter 6-9 then present the empirical findings. Chapter 6 deals with the question how economic activities are organized and controlled by various economic actors in Hangzhou's emerging local business environment. Chapter 7 provides empirical evidence for innovation and patterns of innovation across the three sectors. Chapter 8 then discusses the technological and institutional constraints on innovation as they are experienced by our sample firms. Chapter 9 presents the results of the inductive study and singles out the innovative capabilities that the sample firms developed in response to the constraints in Hangzhou's business environment. Chapter 10 discusses the findings.

Chapter 2

China's software sectors: opportunities and constraints

2.1 Introduction[6]

The transition of China's economy involves both the dismantling of socialist institutions and introduction of market-based institutions, which produces considerable amounts of uncertainty for businesses. It is in this context that the IT sectors emerged. Surprisingly, businesses in these emerging IT sectors show innovative behaviour as opposed to only survival, as argued in the first Chapter. Computer hardware firms benefit from a special governance mode with a collective/public nature that allowed extensive managerial autonomy and access to state – and foreign S&T resources to facilitate top-down mode of technology learning. The software sector, on the contrary, is dominated by private businesses that lack a strong connection to the state's resources and face additional restrictions caused by a low legitimacy, limited access to factors markets and no experience to build on. Therefore, it is surprising that private software firms show innovative behaviour of a non-trivial kind.

In this chapter we will see that a) software sectors are qualitatively different from hardware sectors; b) the software industry is comprised of distinct software sectors with different characteristics and innovation patterns, i.e. strong sectoral variety, necessitating a comparative study of software sectors in order to understand innovation in the software industry; c) the institutional arrangements in China pose specific opportunities and restrictions to the provision and distribution of critical resources for the development of software sectors (i.e. role of the state, human -, private -, and foreign capital).

2.2 China's software business in an evolutionary perspective

China's software business is qualitatively different from the computer hardware business. Whereas computer hardware development in China originates in military and science, software was a by-product of computer hardware. Historically, software was custom-developed for specific equipment and even until the 1980s software bundled with mainframe or minicomputers continued to characterize software development in China, as anywhere in the world. Most producers during the early 1980s were

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government institutes, and a handful of spin-off firms from these research organizations. In this early period software was regarded as a research activity that was concentrated in the Chinese Academy of Sciences (CAS) and research institutes under the various sectoral ministries. The focus in the 1980s is on Chinese character language software processing (Baark, 1990).

In the 1980s Chinese software enterprises started to invest in developing indigenous operating systems and specific applications. A successful example is Founder, established in 1986 by Beijing University, which became the market leader in Chinese language typesetting and publishing software (Lu, 2000). Throughout the 1980s, CAS-driven research continued to be the basis for software development and was the origin for many software firms (Tschang and Xue, 2003). The emerging software industry remained geographically concentrated around the main research institutes and universities. During the 1990s an explosion of computer usage and sales and expansion of the telecommunications sector, provided opportunities for domestic software firms to capitalize on newly emerging markets. Furthermore, the establishment of high-tech parks and software incubators in combination with an inflow of foreign investment and management skills generated opportunities for software enterprises (Baark and Heeks, 1999).

Software development in the last decade is strongly influenced by the revolution of the Internet which enabled network computing and more resources for software development (Mowery, 1999). The Internet craze during the end of the 1990s resulted in a boom of Internet service firms that emerged by the thousands (Wong and Ling, 2000). The late 1990s also saw a surge of government-driven projects focused on promoting the use of software in a variety of sectors, such as the Golden Projects and e-Government projects (Lovelock and Ure, 2002). However, the market is still influenced by attitudes of users and authorities that attach little value to software products, which results in widespread copying of software (Saxenian and Quan, 2005).

In recent years we witness an increased attention of multinationals like Microsoft, Oracle, Adobe, IBM, Lucent, and Intel to start joint R&D activities in China. Oracle and Siemens have expanded and upgraded their R&D facilities in China with Siemens, for instance, opening a 3G software R&D centre in Hangzhou. In 2003, SAP established one of eight SAP Labs in China in Shanghai Pudong Software Park that focuses on creating business software solutions for global local Chinese markets. These companies usually work on large-scale, advanced software projects that are not intended for the domestic market but for foreign markets (Saxenian and Quan, 2005). In sum, the software industry took off late in China but caught-up after the arrival of the Internet and the emergence of private entrepreneurship. Now I will turn to discuss the peculiarities of software development and required resources in more detail.

2.3 Innovation processes and sectoral variety

Software is a collection of instructions that computers follow in executing the task of acquiring, storing and processing data and exchanging them with their human operators, as well as the guides and reference information that humans need to specify what can be, should be or is done in these processes (Steinmueller, 2004). We can distinguish three types of software: generic software, specialized software and middleware. Generic software development focuses on mass customers which have a need for functionality and proprietary standards for information representation. Specialized software usually is custom designed and uses accumulated knowledge that cannot easily be transferred. It faces the problems of informing new users of its existence and capabilities. Middleware has to follow user specifications (high need for functionality), while at the same time customize products via vendor aid and/or software consultancy. This involves complex integration for specific user groups. Middleware is literally 'in the middle' between the operation system (such as Windows Vista) and application software packages (such as SPSS).

Several features make software an unusual business. First, software development involves limited use of physical resources such as land, machines and factories. Second, the most important feature of software development is the importance of human resources (Nowak and Grantham, 2000). Software development is highly knowledge intensive (Ibert, 2004). Software is R&D intensive and has a large role for university-based research and training (Tylecote and Visintin, 2008; Mowery, 1999). It requires intangible skills such as creativity, technical experience and managerial know-how as well as the capacity for commercialization. Clearly, knowledge accumulated in employees of the software firm is a critical resource. Third, software also offers market incentives to recycle solutions and to reuse whole components because the marginal costs for duplication are negligible compared to development costs (Grabher, 2004). Therefore, software has an exceptional position in that it allows studying both radical as well as incremental processes of development and innovation with varied kinds of technical and market risks (Ibert, 2004).

Fourth, the interaction between the computer hardware and software sectors is relatively large (Mowery, 1999). Software development involves users, independent software vendors and hardware producers (Mowery, 1999). Fifth, even though investments in physical infrastructure for production are negligible, investments in distribution and commercialization of software are high. Given that these are high, various forms of appropriability protection are needed in order to achieve economies of scale (Gambardella and Torrisi, 1998). Investments in software are relatively uncertain, competitive and unpredictable, which makes the role of venture capital investments relatively large (Cusumano, 2004; Tylecote and Visintin, 2008).

Innovation in software then has several distinct features. First of all, software faces the problem of interdependencies. Software is dependent on both hardware (to run the programs on) and standards (to allow interoperability). For instance, changes in hardware performance (e.g. quicker processor) affect software development. Secondly, two distinct processes of innovation prevail. On the one hand, software development in complex systemic contexts with high interdependencies allows only incremental changes and improvements. On the other hand, embedded software and Internet software development can make use of asymmetry of information and server/workstation differences to allow radical breakthroughs. The latter process of innovation employs the user interface as a source of innovation, i.e. innovation by design and not in exploitation of new scientific knowledge (Steinmueller, 2004).

Considering these different processes of innovation (radical, incremental) in relation to diverse types of software production (i.e. generic, specialized and middleware), a distinction among software sectors is necessary in order to explain innovation in China's software sectors (cf. Grimaldi and Torrisi, 2001; Casper and Whitley, 2004; Ibert, 2004). In the next section I will argue that a *technological regimes* perspective can help to explain sectoral diversity.

2.4 Technological regimes and sectoral variety: overview of the literature

In order to understand innovation in the software sectors we need to consider sectoral variety. The sectoral systems of innovation (SSI) perspective proves to be useful. The main thesis of the SSI approach is that innovation *in sectors* has specific systemic features (Breschi, Malerba, and Orsenigo, 2000; Kaniovski and Peneder, 2002). The approach shows that sectors with distinct technologies can be differentiated according to their specific technical and market risks, or *technological regimes*, comprised of opportunity and appropriability conditions in addition to characteristics of the knowledge base and degree of cumulativeness (e.g. Malerba, Breschi and Orsenigo, 2000; Malerba and Orsenigo, 1993; Dosi, 1988; Parker & Tamaschke, 2005). These characteristics of technological regimes and its knowledge base provide restrictions the capabilities of firms for innovation (Chapter 1).

Attempting to keep the analysis and results comparable to existing studies on sectoral specialization in developed economies I follow Casper and Whitley (2004) by distinguishing two types of risks: appropriability risk and competence destruction. Appropriability risk summarizes the risk of not reaping profits from investments in innovative activities, for instance due to imitation by competitors. Competence destruction reflects the uncertainty of technical development in terms of the technological trajectory taken and market acceptance of the innovation. These risks identify some conditions that affect the requisite competences, incentives and dynamic

properties of the innovative process (Breschi, Malerba, and Orsenigo, 2000; Kaniovski, and Peneder, 2002; Parker & Tamaschke, 2005).

The link between technological regimes and capabilities has been studied in case studies and statistical exercises. Case study examples of this result are for instance Henderson (1994) and Iansiti and Clark (1994) in pharmaceuticals, computers and automobiles in which capabilities differ across sectors. A recent study linking characteristics of technological regimes to innovative competence development is Casper and Whitley (2004). The research shows that contrasting patterns of innovation can be explained by comparing varieties in institutional frameworks across countries and across sectors where technological risks differ. Other studies reveal patterns of innovative activities linked to specific technological regimes (Breschi, Malerba, and Orsenigo, 2000). Evidence suggests that sectoral characteristics affect innovative capability development. Then, the variety of software sectors with distinct characteristics and innovation patterns necessitate a comparative study.

2.5 Innovation across software sectors in China

This study investigates the enterprise software, middleware and standard software sectors. On the one hand, these three sectors represent the three main software sectors in terms of type of software development (cf. Steinmueller, 2004). On the other hand, they represent sectors with distinct innovation patterns. This allows us to analyse and understand innovative capability development across the most important software sectors and at the same time across different types of innovation (**Table 2.1**).

Table 2.1 – Characteristics of software sub-sectors*

	Enterprise software	Standard software	Middleware
Product/service	'Total-solution'	Novel product	Application
Customers	Few, diverse	Many, similar	Many, similar
Cost model	Service, sale	Sale, licensing	User revenues
Extent of customization	High	Low	Middle
Innovation pattern	Incremental	Radical	Radical
Locus of change	Systemic	Stand alone	Modular
Expected risks of competence destruction	Limited	Considerable	High
Expected imitation risks	Considerable	Limited	Limited
Entry barriers	High	Medium	Low
Capabilities	Knowledge of full process; collective capabilities	Creativity; individual capabilities	Coordination, individual capabilities

** Based on the author, Ibert (2004), Cusumano (2004), Casper & Whitley (2004)*

Innovations carry certain *expected risks* for competence destruction and imitation. These expectations are based on certain conditions. The conditions are influenced by the characteristics of the technological regimes (e.g. uncertainty of market acceptance, uncertainty of investment in technology), the characteristics of the knowledge base and to what extent institutional conditions support the accumulation of knowledge, the development of business routines, accumulation of legitimacy and the availability of visible successful examples in the business environment. These conditions provide restrictions on the development of capabilities and the risk of destroying capabilities and imitation. Therefore, the effect of innovation on capabilities in the standard software and middleware sectors is not necessarily destructive. The following discusses innovation patterns, expected risks and conditions across the sectors.

2.5.1 Enterprise software sector

Enterprise software firms typically develop 'total-solution' products. Examples are enterprise resource planning software (ERP), customer relationship management (CRM), groupware, systems integration products, or sector specific enterprise tools. Chinese examples include Kingdee (Enterprise resource management software) and UFSoft. The latter is China's leading producer of accounting and ERP software, the only private software company listed on the Chinese stock exchange. The market is relatively diverse and customers differ in their requirements. These firms typically have a few large customers, ranging from firms to government departments and universities. The development of products is coordinated within and across the organizational boundaries. Integrated marketing, distribution and other complementary assets lead to complex organizational systems. The 'total solution' character of enterprise software development usually results in extensive customization with integration of production and knowledge with the customer. Revenues are generated by the initial sale, extensive service contracts, and upgrade fees.

The innovation system is systemic with tight constraints on interfaces leading to relatively high switching costs and limited exploration of new activities of the firm. The sunk costs created by and for customer create high specific investments and 'lock-in' customer and enterprise software firm. The business relations are therefore relatively stable and long-term oriented. Most of the innovative activity is incremental, exploiting capabilities and accumulating firm-specific knowledge. Enterprise software development is typically organised in cross-functional teams. Projects focus on creating collective capabilities and knowledge of the full process of software development is crucial (Casper and Whitley, 2004).

Innovation is expected to carry limited risks of destroying competences as there typically is limited uncertainty about market acceptance and investments in technology. Customer requirements are relatively easy to predict and unlikely to change radically

due to the extensively customized services and integrated problem solving and knowledge sharing routines with close customer contact (Whitley, 2006). The innovation process is typically cumulative, building on existing knowledge and skills. Radical changes would be undesirable from the side of the customer and unlikely due to the systemic nature of the innovation process. However, enterprise software development in China faces certain constraints with respect to operational and managerial knowledge. The lack of business routines is potentially problematic because firms typically have to develop (formalised) routines for managing workflows, allocating skills, and monitoring of an ERP project. Difficulties to increase the level of management to ensure proper coordination and control from within the firm might hinder competence enhancement and organizational commitment (cf. Lyles, Saxton, and Watson, 2004; Hoskisson, Eden, Lau, and Wright, 2000)

The imitation risks and uncertainty of appropriability are expected to be considerable as the focus is not on developing unique, radically innovative products but on developing complete (technological) systems for single customers. Innovation is typically cumulative and involves standard skills and knowledge. Whereas such imitation and appropriability risks generally can be mitigated by patent and copyrights protection, China's institutional environment does not have formal mechanisms in place that efficiently protect knowledge and intellectual property (Lau, Lu, Makino, Chen and Yeh, 2002, IFC, 2005). An overall weak property rights protection enlarge the risks of imitation. Enterprises generally try to create complex organizational structures and coordinate activities directly and strongly with customers to create complementarities that are not easily imitated (Lau, Lu, Makino, Chen and Yeh, 2002). However, the unpredictability of the institutional environment does not provide a stable frame in which firms can develop and accumulate firm specific competences. For instance, incomplete labour markets hinder the accumulation of human resources in the organization and increase labour turnover. Furthermore, employers are left uncertain to the extent that employees are committed to the organization and willing to invest in organization specific capabilities in contrast to individual capabilities. How do employers assess their competences? Competence trust is needed, which increases the risk of competence destruction (Sako, 1992).

2.5.2 Standard software sector

Standard software firms develop new products: graphic application software, multimedia and computer entertainment software, and computer network application software. A Chinese example is Founder, a collective enterprise founded by a Beijing University professor. Founder now controls over 80% of China's Chinese language desktop publishing system market and it is a dominant supplier to overseas Chinese newspapers. The standard software market is relatively homogeneous with many

individual customers and users. Standard software is usually not customized for individual customers except for interface modifications. Standard software is sold or licensed to consumer -, business - and government customers and revenue is generated by initial sale or license fees. Innovative activity can be characterised as stand-alone innovation with autonomy of development and limited constraints on interfaces.

Firms typically innovate radically and take advantage of opportunities to establish a dominant design. Standard software products are usually integral products that have multiple functions. Switching costs for consumers are relatively low and stand-alone innovation allows extensive exploration of possibilities. The product must have unique features that customers value to create certain lock-ins to brands or products in order to enjoy scale economies and periodic upgrades. A variety of knowledge and ideas is necessary to create novel products and therefore the emphasis is on individual's skills and know-how rather than firm-specific capabilities. Moreover, the production of standard software involves frequent interaction of technical staff to optimize the performance of products (Ulrich, 1995).

Innovation is expected to carry considerable risks of destroying competences in the pursuit of innovations. In search of the dominant design (McKelvey, 1996) firms typically innovate radically. The risks for competence destruction in China are even higher because of more uncertainty regarding the technological trajectory taken and market acceptance of innovation (cf. Tushman and Anderson, 1986). For instance, a lack of market knowledge is a problem for standard software firms because they need to figure out what unique features will be valued by the customers. A lack of legitimacy will pose certain constraints on attracting a stable customer base, due to unfamiliarity and low switching costs and serious constraints on attracting talented employees. It is hard to locate good employees and it is hard to attract them, either due to the presence of more attractive foreign firms or the lack of reputation.

Standard software development typically faces limited imitation and appropriability risks (Casper and Whitley, 2004). Copyrights and patents are more effective in the case of standard packaged software products then for custom ERP software because it is easier to identify the 'expression' of ideas, i.e. not integrated in a larger system. Moreover, new products can enjoy a stronger form of protection related to increasing return from learning by using and network externalities (Grimaldi and Torrisi, 2001) which might give rise to dominant designs or market standards (McKelvey, 1996). Increasing returns also lead to first-mover advantages that in combination with continuous innovation and possession of skilled personnel create a dynamic appropriability regime (Gambardella and Torrisi, 1998).

Whereas standard software firms typically operate best in an environment with a strong appropriability regime, China's protection of IPRs is weak and software piracy, especially in game software, widespread, which increases risks of imitation.

Furthermore, an incomplete labour market can be problematic for both finding and attracting a variety of experts and assessing the quality of the experts. Standard software firms typically rely on engineers with standardized training in computer languages, but an incomplete formal education system enlarges the uncertainty of technical development, i.e. increases competence destruction risks. However, considering the large untapped Chinese market, standard software firms focus on capturing market opportunities flexibly and quickly. Especially, the small and agile Chinese private entrepreneurs might exploit such institutional ambiguity and uncertainty in the market by moving around relatively quick and creating niches (Tan and Litschert, 1994).

2.5.3 Middleware sector

Middleware firms develop interface technologies that link the basic architecture of digital communication networks to interface application software. Coordination of various technologies is a crucial feature of middleware software. Strongly affected by the development of the Internet, a middleware firm typically develops secure payment systems, (specialized) search engines, or wireless Internet technology. Chinese middleware is dominated by e-commerce, which started to flourish in 1999, with dot-coms such as sohu.com, sina.com, China.com and Netease going public on the NASDAQ exchange. Furthermore investment rushed into the Internet sector, as for instance, Alibaba.com raised $25 million from Softbank, Goldman Sachs, Fidelity and other institutions in 2000 (IFC, 2005). The middleware market is relatively homogeneous and consists of many users. Customization is limited to the modification of the interface by end-users. The cost model of middleware firms is different from enterprise - and standard software firms. The main revenues are generated by the use of the service and not by the actual sale or maintenance of the product. For instance, an Internet search engine generates revenues by ‘clicks’ on banners with advertisements (the advertisement company pays), clicks on generated results (firms that want to end up high in search results pay) or by registration fees (either directly paid by users or the search engine as intermediary for another firm).

Innovation in the middleware sector is in a modular system. Modular products and services are components that accomplish a function through the combination of distinct building blocks or modules (Stone, Wood and Crawford, 2000). By changing modules a firm can introduce new products into the market or upgrade products with limited effort, lead times and costs (Meyer and Utterback, 1993). Middleware firms typically do not develop whole technical systems and there is a common technical standard that governs production and interoperability (Casper and Whitley, 2004; Kitschelt, 1991). The standards on interfaces are open and allow flexibility with limited switching costs. The importance of interdependent technical standards co-

ordination across firms necessitates knowledge about different technological standards. Typically, firms need to follow interface strategies for modular product innovation (Chen and Liu, 2005). The key issue is to secure complementarity and compatibility by a commitment of interface rules in connecting modules (Kano, 2000).

Innovation is expected to carry high risks of destroying competences. Critical skills and knowledge are rapidly changing and firms need to quickly learn and employ new knowledge. Similar to standard software firms, the middleware firms try to capture the market by innovating radically. Innovations are often not stand-alone but modular in nature. In this process there is usually coordination risk, created by uncertainty about which emerging standards in the firm's chosen technical field will succeed. This usually depends on large firms (often telecommunication firms), but, in the case of standards setting in China on the government's decision as to give what standard to which telecom firms. Although this lowers coordination risks with other firms, it increases coordination risks due to the uncertain impact of choosing a specific telecom partner. So, middleware firms will likely exist in the close neighbourhood of telecom firms, within technology clusters and develop skills to learn about standards.

More specifically, these firms face strong liabilities due to the newness of the sector. A lack of knowledge about the business environment hinders locating customers and analyzing their requirements. The latter is important because the revenues are often generated by the frequency of use. Most important, though, is the lack of legitimacy. The middleware market in China is extremely new, with a lot of unfamiliar and inexperienced customers that will constrain the creation of legitimacy. Especially when foreign firms are present with strong brand names, it will be difficult to attract financial resources and talented employees. Firms have no real 'track-record' although some of these issues might be resolved by the coordinated development of innovative activities.

Middleware firms typically face limited imitation appropriability risks because the technology is complex and usually property rights are well protected. Considering China's relatively weak IPR protection, one might expect a higher uncertainty about appropriability. However, middleware firms typically follow a flexible strategy, have no need for strong control and coordination mechanisms which enables these firms to manoeuvre and benefit from opportunities quickly. Whereas coordination within the firm might be small, coordination across the firm boundaries with for instance universities, other firms and R&D institutes to mobilize knowledge and (financial) resources is considerable.

China's environment with incomplete factor markets and ambiguous regulations, especially for newly emerging high-tech sectors (DeWoskin, 2001), has two distinct effects on the middleware firms' innovative activities. On the one hand, the coordination across firms of innovative activities on the basis of open standards is

facilitated by the lack of strongly enforced – bureaucratic – rules and regulations. China is often characterised to be particularly strong in mobilizing resources through personal networks. Furthermore an incomplete and unpredictable labour market will most likely increase labour mobility, which is beneficial for innovative firms that want to have access to a variety of knowledge. On the other hand, incomplete financial markets do make it difficult for firms to attract investments, which is already difficult for new entrepreneurial firms, necessary for R&D and motivating and attracting skilled employees. Skill availability can be a serious problem, especially because it is hard to assess the quality of employees which increases competence destruction risks.

In sum, these sectors have distinct characteristics and patterns of innovation. The remainder of the chapter will discuss opportunities and constraints caused by China's institutional environment. Theory and empirical evidence suggests that institutions play a significant role in facilitating or constraining particular innovative processes (Hage and Hollingsworth, 2000). The institutions that govern capital, labour (e.g. Lazonick, 2007; Whitley, 1999; Crouch et al, 2004) and knowledge (e.g. Edquist, 1997; Crouch et al, 2004) are the key institutions for understanding innovation and technological development: role of the state, skill development and formal education system, and the financial system.

2.6 Role of the state

The central state initiated reforms and programs to restructure and reform technology development within China since 1978. Whereas between 1985 and 1992 the focus was on commercializing technologies by promoting collaborations between state research and enterprises, it was only in the last decade that indigenous technology development was facilitated by inflow of foreign technologies and private entrepreneurship.

Computer hardware firms find their origin in *the first phase of reform* that created incentives for new organizational forms such as New Technology Enterprises (Gu, 1999; Lu, 2000) that focused on commercializing state R&D while upgrading technological capabilities and the development of high-technology zones (specifically, the Torch Plan of 1988). These endeavours created enterprises with a special legal status (Gu, 1996; 1999; Sigurdson, 2004; White, Gao, and Zhang, 2002). In addition, the opening up of China's economy for foreign technologies and capital played a significant role in the early development of the computer sector. In fact, foreign firms dominated the sector in the early 1990s, partly driven by strong market demand and liberalization of foreign policy. Throughout the 1990s, Taiwan and Hong Kong were responsible for a large part of the investments made in the coastal regions and in the process enhanced the technology level and management skill.

Software firms, on the contrary, started to develop in *the latest phase* of the reforms. The industry is dominated by private businesses with few links to the government or the state socialist economy. Tschang and Xue (2005) identify state intervention as the main factor in software industry growth. However, the development of sectors such as the manufacturing sector also boosted demand for computer hardware and software products. Not a lot of state investments went to the software sectors and public procurement of software remains limited (IFC, 2005). However, a host of preferential policies, mostly tax reduction, are intended to facilitate the development of the sectors. First of all, Chinese software companies do not have to pay taxes during their first two years of operation and receive a 50 percent tax break in the third and fourth years. Second, the industry also benefits from simplified administrative procedures and relatively fast approval of foreign investment. Third, local governments have provided financial support for the construction of software parks (World Bank, 2007).

Table 2.2 - Agencies and responsibilities related to the ICT industries

Agency	Responsibilities
Ministry of commerce	Oversees foreign investment
Ministry of information industry	Regulates telecommunications and Internet
Ministry of public security	Enforces commercial and criminal network laws
National development and reform commission	Formulates macroeconomic plans; Budgets for telecommunications infrastructure
National People's Congress	Approves laws
State Administration of Radio, Film and Television	Regulates broadcasting industry;
State Council Informatization Office	Regulates Internet content and other media
State Council Informatization Leading Group	Formulates and coordinates national ICT policies

Source: World Bank, 2007

The government agencies that are responsible for the implementation of the various rules and regulations in the ICT industries is large and diverse. **Table 2.2** shows the variety of decision makers and their areas of responsibility. The consequence is that regulatory authority is often vague and overlapping (World Bank, 2007). The newness of the industry and the rate of development make it difficult for policy makers to keep up. As DeWoskin (2001) observed, sometimes the changes in technology are one step ahead of policy, eventually forcing policy to fit the technology. On the positive side, entrepreneurs are not burdened by complex sets of rules and regulations that characterize the traditional industries. Newly emerging sectors such as the software sectors thrive in such an environment. Generally, the government is promoting the development of ICTs (World Bank, 2007; **Table 2.3** next page).

Table 2.3 - Regulatory changes related to the ICT industries (selection)

Year	Name	Coordinated by	Scope
1993	Golden Projects	State Informatisation Expert Group	Adaption of IT in key sectors: banking, telecom, computer networking for foreign trade
1997	Computer Information Network and Internet Security, Protection and Management Regulations	Ministry of public safety	Regulation of Internet content
1997	Interim regulation of computer networks connection to the Internet	MII	Adoption of Internet protocol
1998	National Foundation for Technological Innovation in technology-based SMEs	State Council	First venture capital fund
1998	Copyright Protection Center of China	State Council	Formal protection of copyrights
1999	Contract Law	Courts	E-commerce: data messages defined as written form
2000	State Council Document Number 18	State council	promoting the development of software and IC industry
2000	Resolution on Internet security	Courts	Definition of online crime
2001	10th five year plan	State council	Software, computers, telecommunications identified as pillar industries
2001	The Notification on Taxation Issues for Encouraging the Development of Software and IC Industries	State council	Tax reduction and exemption to stimulate the development of software and IC industries
2002	Programme of Action for Promotion of the software industry	State Council	Creating a more viable domestic software base and extensive exports of software
2003	Government Procurement Law	State council	Procedures for purchases; priority on domestic goods
2003	Great Firewall	Ministry of Public Security	Creating a Chinese 'intranet'
2004	Regulation of online audio and video programs	SARFT	Regulation of online content
2005	Electronic signature law	MII	Legal validation of data message and authentication

Source: World Bank, 2007; Dahlman & Aubert (2001); Feinstein & Howe (1997); Tai (2006)

The ICT industries have received many forms of preferential treatment and re-allocation and distribution of resources, often in the form of subsidization rather than mere regulation or taxation measures, in contrast to other industries. For instance, Gu (1996) investigated new technology enterprises. Encouraged and supported by the state, R&D institutes started to commercialize their technology – often IT related technology – via establishing profit-oriented enterprises or joint ventures with private investors. Gu identified the important role of state support and the availability of resources from existing institutions. Similarly, studying the software sector, Saxenian and Quan (2005) stress the widespread institutional changes and the persistent role of the government in the development of the software sector. In the same sector, Yang, Ghauri and Sonmez (2005) emphasised the role of government policies in shaping the competitiveness of the industry. In general, the regulations for the IT industry are relatively broad and there is no clear set of regulations that regulate the IT industry.

State intervention also constrains ICT industries' development. The most straightforward constraint is that preferential treatment of sectors or even individual firms hinders the market process. Only the firms that fall in the categories chosen by the central or local governments are supported but this does not mean that firms that do not fit the categories are not potentially innovative or successful. In many cases funds for creating innovative new software enterprises actually go to state-owned or controlled firms (Saxenian and Quan, 2005). Another example is the high-tech zones. In principal these prove to be very beneficial for the enterprises within them, but they are also an institutional device of the government to control resources and influence decisions. The enterprises were obliged to meet certain requirements, such as the number of technical personnel, the allocation of retained earnings and the percentage of sales spent on innovation (Lu, 2000).

Many of the successful plans, such as merging of state R&D institutes and enterprises, did not work as well as the central government had hoped. Experimentation led to the failure of firms and inhibited firms' own initiatives. Only after experimentation, the main bottlenecks came to light: lack of trained engineers, scientists and managers, inexperienced users, a general lack of a technical basis for economic and social development (Lu, 2000; Saxenian and Quan, 2005). A related result of continuous change of policies and regulations is a dynamic but also very uncertain institutional environment. Weak institutions do not contribute to the problem of reducing high uncertainty caused by the technology, competition or the market because – for instance – property rights are not clearly defined (Lau, Lu, Makino, Chen, and Yeh, 2002). In short, the role of the state is diverse and ambiguous in overseeing agents and the implementation of policies for the software sectors.

2.7 Human capital: skill development and the educational system

Human capital is a crucial factor in the development of the software sectors. However, as this section will show, human capital seems insufficiently developed for the demands of emerging IT sectors. The pre-reform period had left its scars on the educational system. Several observers typified it as not sufficient for the development of the necessary human capital (Cheng and DeLany, 1999) and as 'over-centralized' (Mok, 2002). A World Bank study has shown that regulation of the labour market and the skills of employees were the major constraints of the investment climate in China over the past years (World Bank, 2006).

2.7.1 Formal Education: Redefining the Talent Pool

In order to expand the IT sectors, more and better qualified academics and skilled workers were needed. While the latter can be trained in-house, the former have to pass the state controlled university system. The challenge was therefore to reform formal education so that it produced more academics, upgraded technical university programmes and opened new programmes, such as management studies. The results are mixed, as the statistics show that:

1. Basic education is well-developed but access to higher education limited,
2. Technical education is well-developed but management education limited,
3. A low ratio of students returning from abroad indicates a brain drain,
4. The management and finance of the formal educational system has improved substantially as a result of deregulation.

First, the actual rate of growth of human capital in terms of average years of schooling in the population aged 15-64 has declined in the reform period, as compared to the pre-reform period (Wang and Yao, 2003). It seems that access to secondary and tertiary education is problematic, as indicated by the gross enrolment ratios. This is a ratio of total enrolment, regardless of age, to the population of that age group that officially corresponds to the level of education shown (World Bank, 2006). All countries (European, North-American and Asian) have a primary school enrolment ratio of around 100%; this means that the amount of enrolments is as large as the population of the age group that corresponds to that level. However, the secondary and tertiary enrolment rates in China are considerably lower than in other countries. The statistics show that, compared to other countries, the number of people from the age groups that correspond to the secondary and tertiary level that are actually enrolled is very low. Access to higher education remains limited in the 1990s (Wang and Yao 2003) and in recent years: for instance, in 2004 only 12.7% compared to US (71%), Korea (78%) and Japan (48%).

Second, the figures indicate that engineering, management and literature are attracting the most students and deliver the most graduates (**Table 2.4**). It is possible that engineering subjects attract the most students because these subjects are often in the spot-light of government policy; for example the 10th Five-Year Plan focuses on engineering and science related topics such as computers, telecommunications, and biotechnology. Furthermore, the promotion of high- technology products has increased the social legitimacy of such specializations. Management studies are also attracting more students: the number of students enrolled in management studies have increased by 24% in 2003 and the number of management graduates almost doubled in 2003 (46%). However, management studies are still ill-developed and ill-promoted and the absolute number of management graduates remains low. The level of education and management training among Chinese managers continues to be a concern for foreign invested enterprises.

Table 2.4 Students per major in 2003

	Graduates of higher education	Student enrolment in higher education
Philosophy	1,196	5,974
Economics	88,181	604,135
Law	110,416	560,916
Education	117,072	592,123
Literature	286,889	1,719,230
History	13,905	56,673
Science	173,031	1,004,506
Engineering	644,106	3,693,401
Agriculture	50,057	249,671
Medicine	111,356	814,741
Management	281,283	1,784,272
Total	1,877,492	11,085,642

Source: China Statistical Yearbook Online, 2008

Third, in order to import new knowledge students are being sent abroad every year but the number of students returned remains low. At the beginning of the reforms, in 1978, 860 students studied abroad and 248 returned (China Statistical Yearbook Online, 2008). In 2003, the ratio of students abroad to students returned was even more unbalanced: 117,307 remained abroad, while only 20,152 returned. If these statistics are correct, one may speak of a trend. More people are going abroad than returning; and illustrating the so-called 'brain-drain' (Cao, 1996), even though it is impossible to assess the quality of the students that (did not) return. At least half of Chinese students are extending stays or trying to seek permanent residency in foreign countries. The Chinese Embassy in the US estimated that from the 160,000 Chinese students that

came to the US, in the past 20 years, only 20,000 had returned by 1998. However, evidence from Saxenian (2006) suggests that these overseas Chinese are part of global networks that in fact facilitate the knowledge flow across national boundaries. Such reversed brain drain facilitated the growth of for instance the industries in Taiwan.

Fourth, the management and financing of the educational system has improved considerably as a result of deregulation. A considerable change is the new two-level management system consisting of central and local governments with the latter as the main management body. The state gave more autonomy to the local government and institutions (Mok, 2002). The local government is playing a key role in compulsory education, while central and provincial governments are dominant in higher education. In occupational and adult education, social partners, including industrial organizations, businesses and public institutions, are playing a more important role; suggesting the development of on-the-job training. The local governments are also increasingly stimulated to develop higher education and enhance the relationship between education and regional economic and social development (Mok, 2002).

Furthermore, universities are no longer funded exclusively by the government. Calculations from the China Statistical Yearbook indicate that the state's share of educational funding was 84% in 1990 and dropped to 67% in 2000. This does not indicate that the government invests less in education but that there is more investment from other sources: the total funds more than doubled every five years, in the last two decades. China received educational funds from UNESCO and the World Bank and many other international organizations. Furthermore, the government allowed privately-funded educational institutions and private schooling. Wang and Yao (2003) show that the private financing of education has increased but that the distribution is not even and that the distribution of educational funds is even more skewed if one takes private financing into account. Furthermore, it must be noted that China only spent 2.5% of GNP on education in 2001, whereas other developing countries, such as the Philippines, India, South Korea and Singapore spend more than 3% of GNP on education (United Nations, 2002).

In sum, the formal educational system is being upgraded but still remains underdeveloped to meet the needs of the IT industry. Overall, the size of investments in the formal educational system increased and the management improved. There is a wide range of curricula available at various levels of education and more – but still too few – students enter higher education. The large amount of engineers that graduate every year suggests a sound human capital base for high-technology firms. However, the gross enrolment ratio of students in tertiary education is comparatively low and the quality of education is hard to assess. Overall, China has a low percentage of college-educated employees and lags behind world standards (Heckman, 2005).

2.7.2 On the Job Training: Upgrading Management

On-the-job training has become an important strategy for developing technical and management skills (Xiao and Tsang, 1999). The Decision on the Reform and Development of Adult Education (1987) stipulated that job-related training should get the highest priority as a tool to develop job-specific skills that cannot be provided by the formal educational system. This has been implemented in various ways: on-the-job training, job-related technical drills, short-cycle training classes, thematic lectures and supervised self-study (Xie, 1994).

Data on training in Chinese companies is mostly absent, except for some case studies on human resource practices. Cooke's (2002) study on two manufacturing companies show two different approaches. One firm, a beer company, obliged employees to spend 100 hours on training each year to enhance management skills and the production-related skills. The firm had contracts with two universities to provide management training, professional and technical training and further education. In general, the Chinese State Commission organizes several courses and programs for managers and teachers in collaboration with international institutions and organizations. Ding, Fields and Akhtar (1997) study of 158 foreign-invested firms in the Shenzhen Municipality investigated human resource management practices of mainly manufacturing industries and some service and trading industries. They found that managers in foreign invested enterprises (FIEs) in the electronics manufacturing sector received the most training and in the trading business the least. Overall, more than 60-70% of the managers of FIEs in China received training. Of the non-managerial personnel, approximately 50% received training. The major explanation for such high figures is that many FIEs have the obligation to train employees under the Labour Law.

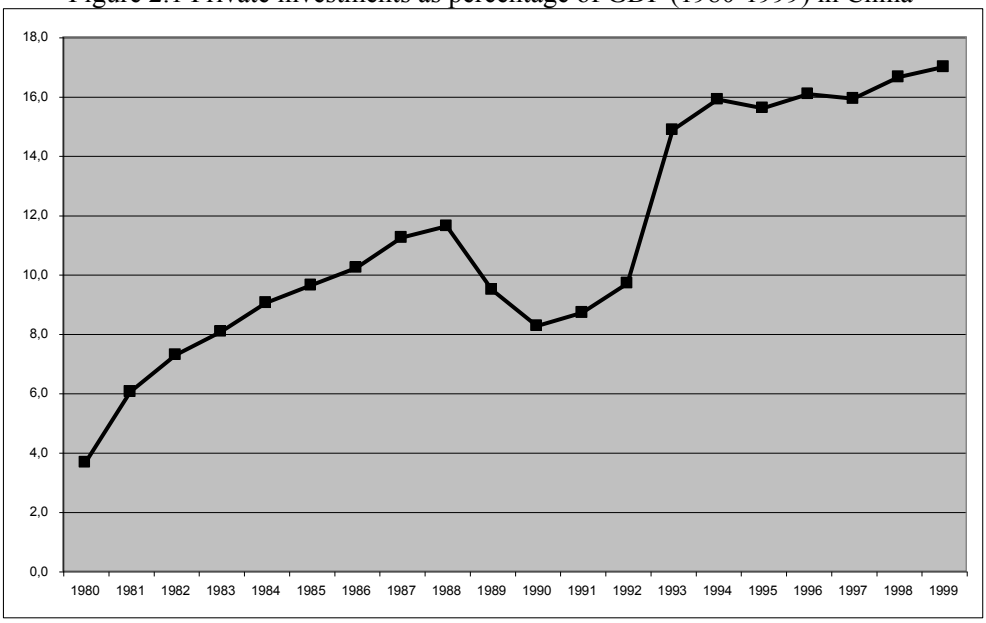
The limited evidence available suggests that in-house training is often provided by firms and that it is directed at upgrading both management and technical skills. As a building block of human capital, on-the-job training is important but the commitment of firms is unclear.

2.8 Private capital

The development of IT sectors includes the emergence of new firms producing new products: where did the capital for these new firms come from? China witnessed a large increase in private capital as is shown by the growth of private capital flows (from USD 8.107 billion in 1990 to USD 59.455 billion in 2003) and significant increase in savings deposits (from 7.12 billion RMB in 1990 to 103.618 billion RMB in 2003). However, an increase in private capital does not necessarily mean an

increase in private investment. **Figure 2.1** shows private investment[7] as a percentage of GDP over the period 1980-1999[8]. There is an overall increase in private investment: from only 3.7% in 1980 to 17% of GDP in 1999. Especially since the early 1990s the share of private investment in the Chinese economy is growing.

Figure 2.1 Private investments as percentage of GDP (1980-1999) in China



Source: IFC (2001)

On the one hand, an increase in private capital boosts demands for new products, as customer's spending power increases. On the other hand, it boosts investments. The People's Daily (2003, 2005) reports in several articles that domestic private capital drives the economy. For instance, domestic private capital investment now accounts for 50% of Shanghai's total infrastructure construction industry. Beijing has seen over 60% of housing investments made by private investors. Many transformed Chinese firms under high financial pressures look for outside financing to realize growth and find private equity investors important partners and an important complement to creditors in shaping the incentives of firms.

The private capital market, however, remains underdeveloped. Private equity, especially venture capital, finds it hard to reach firms, even though most of the venture

[7] Private investment = difference between total gross domestic investment and consolidated public investment.

capital is directed to high-tech industries (Batjargal and Liu, 2004). There are no regulations with respect to the legal and organizational structures and would-be investors, e.g. local governments, set up limited liability corporations. The Company Law, however, inhibits investments of more than 50% of capitalization in subsidiaries or other entities, thus preventing firms from investing more than 50% of their assets in other things than cash-equivalent securities (Tenev, Zhang, and Brefort, 2002).

The result is that the 'common' legal form of venture capital firms in advanced economies such as the United States - the limited liability partnership - is thus not recognized (Batjargal et al., 2004). The main problem is not that the limited liability partnership is the only possible form venture capital firms should adapt, but 'all venture capital firms are registered and operate as limited liability companies, adding confusion as well as serious risks to the processes by which venture capital firms raise, invest, and manage funds.' (Batjargal and Liu, 2004: p.159). Furthermore, as Tenev, Zhang and Brefort (2002) observe 'the state still plays a ubiquitous role as fund sponsor, investor, and manager.' (Tenev, Zhang and Brefort, 2002: p. 72), thereby inhibiting risky investments with potentially high returns. Reforms of the legal framework should promote the development of private capital and equity markets, but still are insufficient.

Concluding, with the private capital market still underdeveloped, the establishment of new firms needs to fall back on traditional, social forms of money raising, such as loans from family members or friends. With most venture capital in the hand of local government agencies, access to capital also depends on successful lobbying and good relations with such agencies.

2.9 Foreign capital

Foreign investment is usually viewed as contributing to economic growth by facilitating technology transfer and marginal productivity improvements. This occurs through the externalities technology transfer may engender - technology transfer in this context means the flow of technology from developed to developing countries (Berthelemy and Demurger, 2000). Numerous studies find that increased foreign investment and international trade had positive effects on economic growth (Chuang and Hsu, 2004; Hobday, 1994). Gereffi (1999) argues that better positions in international trade networks allowed East-Asia's apparel manufacturers to upgrade from labour-intensive assembly to skill-intensive full-package supply of new goods and services. However, it remains to be seen whether such upgrading actually takes place in the case of China.

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[8] These data are obtained from the IFC data set "Trends in Private Investment in Developing Countries: Statistics for 1970-2000" and do not include more recent years.

As several studies on the role of foreign trade and investment in China suggest, the strong reliance on foreign investment may not be so forthcoming to China's domestic private entrepreneurs (Huang, 2001; Lardy, 1995). Huang (2001) argues quite convincingly that FDI came to China because of the opportunities for foreign investors to invest in state-owned enterprises (SOEs) because of the political capital necessary to invest in China. Subsequently, China has had rapid export growth rates but this has depended highly on foreign invested firms. As Lardy (1995) and Huang (2001) conclude, this high reliance on FDI for maintaining export rates and aiding the privatization of SOEs, actually inhibited the growth of the private sector, mainly by missing backward linkages and low domestic content of exports.

The proximity of the southern coastal provinces to Hong Kong and Taiwan is especially significant in the IT industry. Taiwan started the electronics development in the 1950s (Hobday, 1995) and has many small firm innovation clusters. Technological development in Hong Kong, on the other hand, is characterized by *laissez-faire*, market-led industrialization. In the early 1990s, large numbers of firms relocated into China, as wages rose. Hong Kong and Taiwan became the largest investors in China (Sun, Tong, and Yu, 2002). Both Hong Kong and Taiwan provided domestic Chinese IT firms access to the international market, although it is unclear whether this actually led to better positions in international trade that helped upgrading the operations. It is clear, however, that the economies in the region – Hong Kong, Taiwan and China – have become more intertwined. Adams and Davis (1994) and Elek (1994) argue that this might reduce the significance of government policies.

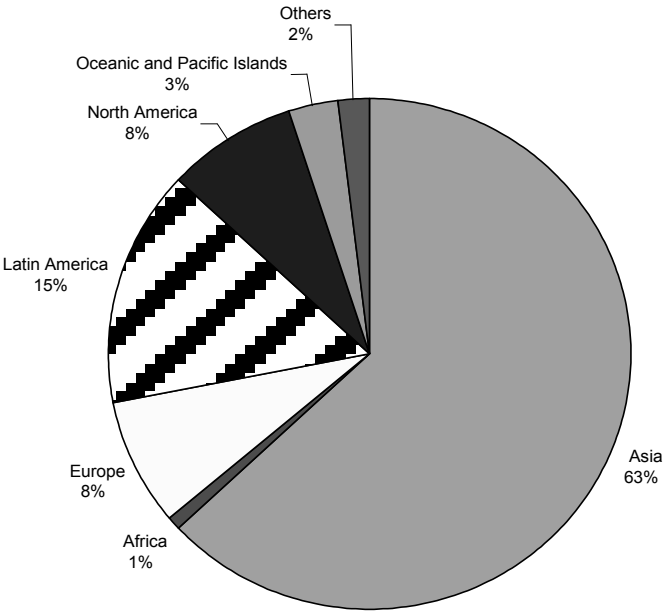
The development of China's IT industry is characterized by the strong presence of Hong Kong and Taiwan firms, as well as multinationals, demonstrating the dramatic change in China's foreign trade policy. Indeed, the statistics show that:

1. FDI increased in response to deregulation of markets,
2. FDI is often Asian, with Hong Kong and Taiwan playing the leading roles,
3. Foreign firms tend to establish subsidiaries rather than joint-ventures when this became an option,
4. FDI became a new channel for technology transfer,
5. FDI might not be 'really' foreign, leading one to question the extent of technology transfer and learning of new capabilities.

First, foreign direct investment increased sharply in response to the deregulation of foreign investment policy. The total inflow of foreign capital increased from USD 4.5 billion in 1985 to USD 64 billion in 2004. From the early 1990s onwards, the composition of total foreign investment changed. Even though some foreign capital is still from loans or other foreign investments, it has become predominantly direct

investment (FDI). There has been an increase in investment from USD 1.7 billion in 1985 to USD 60.63 billion in 2004. There are two phases of FDI inflows (Sun, Tong, and Yu, 2002; Yi, Zhang, Men, and Huang, 2004). The first phase is between 1979 and 1991. In the first half of this phase, FDI is concentrated on particular state-owned traditional industries in the coastal regions. In the second half, access was extended to a limited amount of other industries and some central regions. During this phase, the Open Door policy was predominantly restricted to the coastal region, foreign investors had limited access to the Chinese domestic market and the range of industries in which foreigners could invest was restricted. In the second phase opening up was extended to all regions, the pace was accelerated, the domestic market has been further opened, and the direction shifted from a regional to an industry orientation. China maintained a strong specialization in traditional industries (for example clothing), but also started to build up new, technologically advanced industries (for example computer equipment).

Figure 2.2 Foreign direct investments per world region to China in 2004



Source: China Statistical Yearbook Online, 2008

Second, most foreign direct investment is coming from the Asian region (**Figure 2.2**). Hong Kong, Japan, Taiwan, Korea and Singapore invest approximately 95% of total Asian FDI (China Statistical Yearbook Online, 2008). Hong Kong and Taiwan have

been particularly important as foreign players in the Chinese IT sectors. Given the inequality in population, size and resources they play a remarkable role. China received almost USD 60.63 billion of foreign direct investment in 2003. The share of Hong Kong and Taiwan of the total amount is 36% (China Statistical Yearbook Online, 2008). Furthermore, the amount of trade with Hong Kong and Taiwan is substantial. In 2004, China traded almost 29% of its Asian trade with Hong Kong and Taiwan; culminating to almost 17% of the world total. It must be noted that Japan remains the largest trading partner with 27% of China's Asian trade and 16% of China's trade.

Third, the entry mode changed from cooperative enterprises to subsidiaries with a considerably stronger commitment when this became an option. Yi, Zhang, Men and Huang (2004) identified four ways in which FDI enters China: joint-venture enterprises (JVEs), cooperative operation enterprises (COEs), foreign investment enterprises (FIEs) and cooperation development (CD). Until 1992, the total amount of FDI was small and the COE and CD entry modes were dominant. The turning-point is in the early 1990s. From this point onwards the share of foreign investment enterprises increases to almost 50% of total FDI. The share of COE and CD declined when more structural investments were allowed and foreign investors were allowed to make stronger commitments. The more rights and opportunities were given to foreign enterprises, the larger the inflow of investment.

Fourth, foreign investment became a *new* channel for technology import besides capital accumulation and importing management skills (Wang, Wu, and Li, 1998; Zhao, 1995). During the process, localities got more authority and enterprises were given more responsibility through various policy reforms. As Piek (1998, p. 35) observed 'decentralisation of institutions and lifting of state's monopoly in the foreign sector stimulates domestic enterprises to enter the world market'. For many IT firms, foreign investment had positive effects by increasing investments, transfer of knowledge and new markets.

Fifth, although a large stock of FDI has entered China, the story is perhaps not as rosy as the figures suggest. The FDI per capita is not large, compared to other Asian countries. For example, stock per capita in China is USD 160 (approximately 860 RMB), in Thailand USD 320 and in Malaysia USD 2000 (World Development Indicators, 2006). The distribution of FDI is very uneven with a concentration in the coastal provinces. Furthermore, it is unclear to what extent FDI is actually really 'foreign' and, subsequently, to what extent transfer of technology takes place through foreign investment. Graham and Wada (2001) argue that (unspecified) parts of Hong Kong FDI, the largest source of FDI, is in fact of domestic Chinese origin, which is 'round-tripped' through Hong Kong, or Western nations and Taiwan that enters China through Hong Kong intermediaries. Huang (2001) argues that round-tripping of foreign capital was actually promoted by the foreign investment policies of the

government which favoured foreign enterprises over domestic enterprises. Furthermore, he finds, as Lardy (1995) did, that China's high reliance on FDI is not healthy because it inhibits the private sector by creating more competition and giving more preferential treatment to such foreign invested firms and protection of SOEs, thereby inhibiting productivity growth. The main problem of round tripped foreign capital is that it does not involve technology transfer and learning of new capabilities, which questions the benefits from the increase in FDI.

2.10 Summary and discussion

Software sub sectors show considerable variety in technologies, markets and institutional requirements. Therefore, it is necessary to take a comparative sectoral perspective on innovation in the software industry. More precisely, I choose to study the following three sectors: standard (generic), enterprise (specialized), and middleware. On the one hand, these three sectors represent the three main software sectors in terms of type of software development. On the other hand, they represent sectors with distinct innovation patterns. This allows us to analyse and understand innovative capability development not only across the most important software sectors but also across different types of innovation. The sectoral systems of innovation perspective suggests that we can compare sectors on their specific *technological regime*. I have shown that the three software sectors have qualitatively different technological regimes. Therefore, the three software sectors are expected to require different capabilities for innovation. In short, innovation involves developing capabilities that can mitigate *sectoral constraints.*

Furthermore the chapter provided an analysis of China's institutions that influence the development and provision of critical resources for IT sectors. The analysis shows that in China during the past three decades resources were created and mobilized that facilitated the growth of IT industries in general and software in particular. Specifically, I focused on the provision and distribution of critical resources for software development in China: state, human -, private - and foreign capital. It is useful to summarize the main findings.

First, an increase in foreign investment inflow, a growing – although still very limited – venture capital market and an increase in private savings as a result of deregulation of foreign and capital policy have boosted investment and competition. Whereas the central government sets the overall targets, individual firms are increasingly in control of the management of foreign capital inflow, coming predominantly from Hong Kong, Taiwan and Japan. Accumulation of private capital in combination with increasing legitimacy of information products and services in the domestic market boosted private investments. However, the constraints on financing are considerable. The state dominates banking and makes it difficult for non-state or

non-favoured firms to get loans. Moreover, there is a large competitive pressure for financing with an uneven or unequal reception of foreign and state investments; ambiguity and preferential treatment increases the difficulty of private financing. The key issue for private software firms is: how to attract committed financial capital?

Second, the government attempts to upgrade China's human capital base through a thorough reform of the formal educational system and increased emphasis on on-the-job training in combination with imported foreign expertise. The state is no longer the sole provider of education and training and there is an increasing role (and demand) for employer's training. The overall investment in the formal educational system has increased but it remains too weak to supply the demand for innovation in the IT industry. It has to be noted that there is general scarcity in skilled labour and a large extent of geographical variety. Therefore, the challenges for the software sectors remain relatively large: how to find and commit suitable employees?

Third, one of the major goals of state intervention was the promotion of entrepreneurship. The state's arm's length approach to regulation and promotion – often direct subsidisation - of specific IT initiatives has created many incentives for entrepreneurs. Furthermore, the state's knowledge sharing initiatives, involving R&D institutes, banks and (regional or sectoral) technology zones, has resulted in new forms of profit-oriented SOEs; collective or collective-private enterprises subordinate to specific R&D institutes. However, it is noteworthy that the enforcement of the various regulations and policies is somewhat vague and ambiguous, as a consequence of a variety of responsible authorities.

These opportunities and restrictions show local and sectoral variety. For instance, the state has both regional and industrial policies to economic development; there is geographic variety in the provision and quality of human resources and foreign investment is unevenly received by different sectors and regions. The next step is to explore how firms actually have dealt with and used these opportunities and restrictions. How capabilities are built, maintained and used needs to be further explored and is the subject of the next chapters.

Chapter 3

Innovative capabilities and institutional regimes in China: Towards an analytical guide

3.1 Introduction

The preceding chapter described the innovation patterns and associated technical and market risks of three software sectors in China. Furthermore, the chapter presented the opportunities and constraints for software development in China. However, these constraints are not necessarily 'hard' constraints. This chapter explores the literature to develop an analytical guide for my empirical study to understand how Chinese private software entrepreneurs have overcome constraints arising from technologies, market and institutions. The focus is on what kinds of capabilities for innovation are developed in response to what sorts of restrictions. We will explore the key concepts and apply them to China's context. What is the nature of innovation in China? What are innovative capabilities? What are the features of institutional regimes and how do they relate to innovative capability development? Moreover, what are the features of China's institutional regimes? Answers to these questions will provide a framework for designing the empirical study. The chapter concludes by outlining the main intellectual goals of this study.

3.2 Innovation

Innovation can be described as a first attempt to carry out an idea for a new product or process into practice. More specifically, in this study I consider innovation to be introductions of new knowledge or new combinations of existing knowledge. Innovation can be usefully classified according to types, with the most prominent categorization being the following: new product and methods of production, new ways of organizing the value chain, opening new markets for goods and services and new ways to organize business (Schumpeter, 1934). The focus in innovation studies has been on the first two: product and process innovation (Fagerberg, Mowery and Nelson, 2007). Most studies investigate innovation in relatively developed economies which are at the forefront of technological advancement in the last century. However, China and other developing countries are currently catching-up in which upgrading and adapting of technologies and capabilities has the focus. This is not to say that China shows no innovative behaviour in product or process technologies, take for example of 3G and 4G mobile telecommunications research or the pictographic-language electronic publishing systems (Lu, 2000). It also doesn´t mean that China has not been

innovative in the past, being the originator of many breakthrough innovations. However, China's scientific and technological development did suffer a severe blow during the Cultural Revolution which pushed China's Science & Technology system back. This might mean that China is likely to be less successful in product and process innovation due to the lack of competitive technological bases and suggests that the latter three categories of Schumpeter's categorization of innovation might have more significance in this stage of China's economic development.

A similar argument has been put forth by Hobday (2000) who argues that economic and technological development has not only relied on simple imitation of 'Western' technologies but also on innovation by introducing innovations in new contexts. Similarly, Fagerberg and Godinho (2007) argue that successfully catching-up historically also involved innovation, 'particularly of the organizational kind, and with inroads into nascent industries' (p. 515). To put this in an even broader perspective, historical studies on the economic and technical success of the United States in the first half of the last century show that many of the innovations involved new ways to organization production and distributions (Bruland and Mowery, 2004). Therefore it is crucial to understand innovation in technology and organization.

3.2.1 Technical innovation

The technology-focused innovation literature distinguishes innovations in terms of types, technical characteristics and competence effects. A common distinction is between radical and incremental innovation (e.g. Nelson and Winter, 1982; Damanpour, 1991; Ehrnberg, 1995). The former improves price/performance within the existing technical trajectory. The latter improves the price/performance frontier by more than the existing rate of progress of technology. Closely related is the distinction between competence-enhancing and competence-destroying innovations (Tushman and Anderson, 1990). Whereas the former builds on existing competences, the latter innovations require new skills, abilities and knowledge in the development and production of a product or service, i.e. the innovation renders obsolete the expertise required to master the technology that it replaces (Henderson and Clark, 1990).

Radical innovation can have both enhancing and destroying effects on firm's competences, depending on the firm's history and context. Although these dimensions are independent, radical innovations are often riskier with higher returns and have more profound effects on firm's competences than incremental innovation (Gatignon et al, 2002). Christensen and Bower (1995) focus on the market effects of innovation. Disruptiveness of innovations depends on the resistance of current customers and the way resources are allocated to innovation that is associated with new customers. Chandy and Tellis (2000) look at both customer and technological factors and argue

that radical product innovation involves both a substantially different core technology and substantially higher benefits for customers relative to existing products.

A slightly different approach is offered by Abernathy and Clark (1985) who see products as hierarchies of subsystems. Central sub systems are more tightly coupled and integrated and they drive the more loosely coupled peripheral subsystems. Innovation can then be defined according to market-customer – and technology-production linkages. Henderson and Clark (1990) extend this argument by distinguishing innovations that change core systems (generational innovation) from those that change the linkages between systems (architectural innovation). Interestingly, this kind of innovation is often associated with strong organizational effects, in contrast to technological effects. Changes in components of the system are then referred to as modular innovation. Generally, modular innovation is seen as allowing a firm to exploit certain technical opportunities to improve parts of their product, differentiate or adapt to quickly changing customer demands, i.e. leaving the firm's innovation rather flexible within a set frame.

In sum, innovation can be radical or incremental compared to the existing technological trajectory and set of product offered to customers and can be more or less connected to other 'components', such as customers and the organization. Whereas the consequences of innovation for the competences of a firm can be destroying or enhancing, the characteristics of innovation are independent of its consequences for capabilities.

3.2.2 Organizational innovation

At least as important as the technical and market oriented innovations are organizational innovations. They are commonly defined as the creation or adoption of an idea or behaviour new for an organization (Hage, 1999). Technical and organizational innovation is to a large extent intertwined, as the effects of technical innovation on organizations cannot be ignored. Organizational innovation involves not only process improvements within a given firm, but also includes 'arrangements across firms such as the reorganization of entire industries' (p. 7). Usually the research on organizational innovation explores to what extent an organization is possible to innovate. As the review of Lam (2007) shows, most research has focused on organizational structure that, in contingency theory parlance, focuses on best fits between structure, contexts and innovative activities.

Two studies stand out: Teece's (1998) exploration of organizations' structure and strategy and nature of technological innovation and Lazonick's (2007) theory of innovative enterprise. Teece distinguishes two main types of innovation: systemic and autonomous innovation. By identifying four types of corporate governance modes based on organizational requirements for innovation he argues that different types of

innovation require different organizational modes. Systemic innovation requires complex coordination amongst various subsystems, whereas autonomous innovation does not require substantial modification of related products and processes with relatively simple coordination. Lazonick's theory of innovative enterprise focuses on the role of strategizing, financing, and organizing. Drawing attention to the organizational integration hypothesis, Lazonick points at the social structure and internal organizational coherence as determinants of innovative enterprise.

In sum, it is innovation in organizational structures – often in connection to technical innovations - that can be the source of competitive advantage of a firm.

3.2.3 Features of innovation

Considering the literature on technical and organizational innovations, innovations are usually described in terms of how *radical* and how *autonomous* the innovation is. This distinction is useful for the purpose of this study as software involves both radical and incremental processes of innovation with varying degrees of autonomy (Chapter 2). Moreover, since we are interested in identifying capabilities for innovation without assuming the consequences of those innovations on capabilities, we do not differentiate competence enhancing versus destroying innovations.

Some firms pursue *incremental innovation* involving refining, improving, and exploiting an existing technological trajectory and offering products and services that differ only marginally from existing products and services, whereas other firms follow *radical innovation* disrupting an existing technological trajectory, i.e. substantially different core technology, and offer substantially different product/services for customers relative to existing products/services in the industry. Furthermore, innovations can differ in their systemic features: *systemic*, *modular* or *stand-alone* (Nooteboom, 2004). A systemic innovation has tight constraints on interfaces (e.g. telecom industry, enterprise resource planning software) leading to high switching costs and limited exploration of new activities. A modular innovation has certain standards on interfaces but they allow flexibility and thus has limited switching costs (e.g. consultancy, middleware software). A stand-alone innovation is characterised by autonomy of elements and limited constraints on interfaces (e.g. application based software) resulting in low switching costs and extensive exploration possibilities.

To be able to innovate, firms require capabilities (Branzei and Vertinsky, 2006). Such capabilities help to organize the search and combination of resources for new technologies. Innovative capabilities can become a source for competitive advantage (Whitley, 1999; Coriat and Weinstein, 2002). The next section deals with the nature of capabilities and main features of innovative capabilities.

3.3 Capabilities for innovation

What are innovative capabilities? Whereas early resource- and capability studies focus on relatively static and stable sources for capabilities, these ideas are recently being extended to explore the dynamics of how firms gain and loose competitive advantages (Teece et al., 1997). A capability, in its broadest interpretation, enables a firm to grow and take advantage of its opportunities (Penrose, 1959; Wernerfelt, 1984). It is useful to single out the main features of capabilities in order to define innovative capability.

Penrose (1959) formulated a theory of the firm that sees it as an organization that coordinates a collection of human and physical resources, in which learning to use resources is a key process. Wernerfelt (1984) extended this work and drew attention to strategic thinking to balance the use of existing resources and the development of new. A further extension is the distinction between tradable and non-tradable resources by Dierickx and Cool (1989), which allows analysis of 'soft' resources such as reputation. Chatterjee and Wernerfelt (1991) argue that firms strategically respond to the existence of excess resources and that such resource heterogeneity may lead to competitive advantages. In the same year Barney suggests that firms in search for competitive advantages need to focus on those resources that are valuable, rare, imperfectly imitable and non-substitutable, assuming path dependence, causal ambiguity, and social complexity (Barney, 1991). The basic contention is that firms achieve a competitive advantage by focusing on specific organizational capabilities that can be achieved through *combinations of unique, non-replicable resources*.

The dynamic capabilities perspective has extended these ideas to an alternative to uniqueness of resources. Instead of being based on unique resources, the dynamic capabilities approach focuses on managerial competences and difficult to imitate combinations of organizational skills (Teece, Pisano and Shuen, 1997). In this sense not only markets (for resources) are flexible and dynamic but also capabilities. Capabilities are collective and socially embedded in the organization and allow a firm to mobilize and transform resources in a more or less reliable way to achieve a certain desirable goal (cf. Amit and Schoemaker, 1993; Dosi, Nelson and Winter, 2000; Whitley, 2003). Dynamic capabilities then refer to the firm's 'ability to integrate, build and reconfigure internal and external competences to address rapidly changing environment' (Teece, et al., 1997, p. 516). Similarly, Eisenhardt and Martin (2000) see such capabilities as identifiable organizational processes through which managers integrate, combine and utilize resources to develop value-creating strategies. Dynamic capabilities are contingent on path dependencies, market positions, environmental shifts and the crucial role of strategic managers to *adopt, integrate and re-configure skills, resources and competences* (Teece and Pisano, 1994).

Teece and Pisano (1994) distinguish three types of collective capabilities: coordination, organizational learning and reconfigurational capabilities. These

capabilities vary in the extent of flexibility and can result in incremental or more radical changes in competences, depending on different technological and market situations. Another example of a capability is a firm's absorptive capacity (Cohen and Levinthal, 1990). Prior related knowledge confers an ability to see the value of new information, absorb that information and apply it in novel ways. Similarly Henderson and Cockburn (1990) argue that architectural competences convey the firm's ability to use component competences and integrate them effectively and develop fresh component competences as they are required. They include knowledge about communication channels, information filters and problem solving and are contingent on organizational characteristics. A slightly different approach is taken by Leonard-Barton (1992) who considers employee knowledge and skills, technical and managerial systems and wider norms and values as constituting core capabilities. Collective capabilities are predominantly seen as *'problem solving routines' that are based on firm specific skills and characteristics.*

Kogut and Zander (1992) take a knowledge-based perspective and argue that knowledge is held by individuals but also can be found in regularities in groups, which implies organizational learning. They theorize that organizations have both internal and external learning processes by which firms synthesize and acquire knowledge resources and generate new application from those recourses: combinative capabilities. Similarly, Grant (1996) sees capabilities as the outcome of knowledge integration by complex team-based productive activities. Dyer and Singh (1996) extend the knowledge based by arguing that a firm's critical resources might span the boundaries of the firm. They propose to look at inter-organizational competitive advantages arising from relation-specific assets, knowledge-sharing routines, complementary capabilities and effective governance. These approaches emphasize the *role of external knowledge resources and the mechanisms of combining knowledge resources*.

More recently, Helfat and Peteraf (2003) introduced the capability life cycle that shows that there are general patterns and paths in the evolution of capabilities over time. Certain organizational and environmental conditions influence their founding, development, maturation, and alteration but it is managerial decisions that are critical antecedents of capability transformation (Adner and Helfat, 2003). Similarly, Teece (2007) extends the dynamic capabilities framework by explicating the micro-foundations and associated capabilities in a process model. Crucial capabilities become sensing, seizing and managing threats. Enterprises with dynamic capabilities are very entrepreneurial and do not only adapt to business environments but also transform them through innovation and collaboration (Teece, 2007). These recent studies emphasise *the agency of managers* in forming dynamic capabilities and *the role of risks in the business environment that shape dynamic capabilities*.

This set of studies suggests that capabilities are neither vague nor unfocused processes but specific processes that manipulate a firm's resources base. More precisely, the previous studies on capabilities suggest that capabilities combine unique, non-replicable resources (Amit and Schoemaker (1993); adopt, integrate and re-configure skills, resources and competences (Teece and Pisano, 1994); solve problems based on firm specific skills and characteristics (Henderson and Cockburn, 1990; Leonard-Barton, 1992); are mechanisms of mobilizing and combining (knowledge) resources across firm boundaries (Kogut and Zander, 1992; Dyer and Singh, 1996); respond to risks and threats in the business environment (Adner and Helfat, 2003; Teece, 2007). Therefore, we define innovative capabilities as *the firm's ability to integrate, build and reconfigure internal and external resources to develop and successfully commercialize new products and services.*

3.4 Antecedents to innovative capabilities

Not all organizational processes can be transformed into innovative capabilities that give the firm a competitive advantage (cf. Teece et al, 1997). Where do innovative capabilities come from? The literature on dynamic capabilities suggests that it is important to identify the antecedents to capabilities. An antecedent is here understood as a cause or origin of capabilities (Rothaermel and Hess, 2007). While an understanding of the antecedents to factors associated with performance is important, it is not often researched (exceptions are Cockburn et al, 2000; Ahuja and Katila, 2004; Cattani, 2005). Recent theoretical studies suggest that antecedents to dynamic capabilities can be found at the individual, firm, or network level (Eisenhardt and Martin, 2000; Zollo and Winter 2002). More recently, empirical studies such as Hsu and Lim (2006) and Rothaermel and Hess (2007) confirm that antecedents to dynamic capabilities can indeed be found at different levels. In this thesis, we define antecedents to innovative capabilities as those organizational processes that provide resources (originating in individual, firm or network) to the firm that can give a potential competitive advantage in successfully developing and commercializing new products and services. For instance, hiring talented engineers, acquiring a new technology and inviting experts to give a training are all antecedents. However, these antecedents do not necessarily add up to innovative capabilities.

Eisenhardt and Brown (1999) and Eisenhardt and Martin (2000) provide the best available criteria for understanding when antecedents become capabilities. They investigated how specific organizational processes became dynamic capabilities: only if processes combine and deploy resources to generate value-creating strategies and which are able to span and support multiple lines of business of the firm, i.e. organization-specific. These processes are the drivers behind the creation and combination of existing resources into new sources of competitive advantage, i.e.

antecedents to capabilities (Henderson and Cockburn, 1994). Following our definition, capabilities involve integrating, building and reconfiguring internal and external resources to successfully develop and commercialize new products and services. Antecedents add up to a capability only if they alter the firm's resource base to the extent that they generate organization-specific, value-creating strategies for innovation. Antecedents to a specific capability are all aspects of the same capability but refer to different organizational processes that together generate organization-specific abilities of the firm to integrate, build and reconfigure internal and external resources. In our example, mobilizing external knowledge could be a capability and the three organizational processes antecedents.

Generally, innovation relies to a large extent on external sources and it depends on extensive interaction with its environment (Fagerberg, Mowery and Nelson, 2007). A combination of internal and external drivers become the source for innovation. For instance 'absorptive capacity' of the firm (Cohen and Levinthal, 1990), an internal driver, is necessary to reap the benefits from new knowledge from external sources. Together they allow a firm to combine its entire knowledge base when confronting new challenges (Nonaka and Takeuchi, 1995).

In total there were 212 unique antecedents of successful innovation identified in the literature. These antecedents were categorised according to topics. From these 212 potential antecedents, 16 categories emerged. The criteria for reducing the 212 potential antecedents to 16 were the following: 1) theoretically meaningful categories that match the conceptual definition of innovative capability; 2) deletion of overlapping or strongly related antecedents (e.g. business ties, business group, cooperation with university were combined into 'external partner'); 3) deletion of antecedents that were only mentioned once. However, most important was the confrontation of the set of antecedents with the conceptual literature and the research problem under investigation in this study.

Several studies suggest the importance of *acquisition of new technology* from other firms or institutes. For instance, firms can assemble a changing set of products and technical know-how that drives superior performance. Acquiring external technical know-how can supplement internal knowledge development (Rothaermel and Hess, 2007). Moreover, the *use of external partners* for joint research projects, extensive information flows and access to a variety of knowledge is often stressed (Damanpour, 1991; Whitley, 2002). *Employees* with diverse expertise backgrounds and attracting new talents are crucial for firms pursuing more radical innovation strategies (Henderson and Cockburn, 1994). Besides using inter-firm collaborations to access and mobilize resources, the *coordination of networks of resources* is also often seen as an important advantage. So-called innovation networks are then viewed as loosely coupled systems of autonomous firms, in which hub firms 'orchestrate'

network activities (Dhanaraj and Parke, 2006). Next, *access to finance* is crucial for capital-intensive innovative activities. This refers to the availability of funds within the firm but also to the effectiveness of (venture) capital funding (Lee, Lee and Pennings, 2001). Lastly, *reputation* is important for firms to overcome imperfections in knowledge markets (Lichtenthaler and Ernst, 2006; Henderson and Cockburn, 1994). **Table 3.1** presents a summary.

Table 3.1: Potential antecedents to innovative capabilities

Antecedent	**Studies**
Developed economies	
External	
Acquisition of new technology	Eisenhardt and Martin, 2000; Kogut and Zander, 1992; Rothearmel and Hess, 2007
Use of external partners for new knowledge	Hagedoorn and Duysters, 2002; Eisenhardt and Martin, 2000; Whitley 2002; Kogut and Zander, 2002; Rothearmel and Hess, 2007; Damanpour, 1991
Expert employees with diverse backgrounds	Souitaris, 2002; Eisenhardt and Martin, 2000; Henderson and Cockburn, 1994; Damanpour, 1991
Coordination of innovation networks	Powell, Koput and Smith-Doerr, 1996; Lorenzoni and Lipparini, 1999; Brusoni, 2005; Dhanaraj and Parkhe, 2006
Access to finance	Lazonick, 2007, Lee, Lee and Pennings, 2001; Souitaris, 2002; Florida and Kenney, 1988; Kortum and Lerner, 1998
Reputation	Lichtenthaler and Ernst, 2006; Henderson and Cockburn, 1994
Internal	
Technical capacity	Rothaermel and Hess, 2006; Lee, Lee and Pennings, 2001; Damanpour 1991; Henderson and Cockburn, 1994
Flexible strategy	Casper and Whitley, 2004, Whitley, 2002, Kogut and Zander, 1992; Lazonick, 2007, Lado and Wilson, 1994
CEO experience	Lynskey, 2004; Souitaris, 2002, Grabher and Ibert, 2006
Firm-specific knowledge	Eisenhardt and Martin, 2000; Whitley, 2003; Damanpour, 1991; Henderson and Cockburn, 1994; Leonard-Barton, 1992
Innovation orientation	Gavetti, 2005; Souitaris, 2002; Zollo and Winter, 2002; Alvarez and Busenitz, 2001
China	
Formal/informal external partners	Xin and Pearce, 1996; Tan, 2005; Krug, 2004; Peng and Luo, 2000; Tsang, 1996; Wang, Lo and Yang, 2004;
Interaction with government	Saxenian and Quan, 2005, Li and Atuahene-Gima, 2002; Peng and Luo, 2000, Wan, 2005
Strategic swiftness	Meyer and Peng, 2005; Tan, 2005; Lyles, 2004; Krug, 2004
Founder network	Peng, 2003; Batjargal, 2007, Lyles, 2004
Technical capacity	Wan, 2005; Tan, 2005; Yam, Guan, Pun and Tang, 2004

Studies also suggest internally-oriented antecedents for successful innovation. A strong *technical capacity* and large pool of competent experts is traditionally one of the major sources of innovation success (Henderson and Cockburn, 1994). Strongly related to internal capability development is the extent of organizational integration or *firm-specific expertise* (Damanpour, 1991; Eisenhardt and Martin, 2000; Whitley, 2003). To what extent firms develop firm-specific knowledge and learning depends on the type of innovation and type of strategy the firm pursues. For more radical innovation a *flexible strategy* is preferred. This refers to be able to respond quickly to customer demands and opportunities in new technologies (Kogut and Zander, 1992; Whitley, 2002). Closely related to the strategic direction of the firm is the *orientation* of the firm towards innovation. On the one hand, this refers to the extent to which firms are entrepreneurial. On the other hand, it refers to the experience of the firm in innovation. Usually this involves local knowledge and experience (Damanpour, 1991; Gavetti, 2005). Related to this is the role and experience of the CEO-founder in innovation and entrepreneurship and the knowledge and networks brought to the firm (Lynskey, 2004; Grabher and Ibert, 2006).

Studies focusing on Chinese innovation, stress the role of various kinds of formal and informal *business networks* in overcoming the constraints of a weak institutional environment (Peng and Luo, 2000; Tan, 2005; Xin and Pearce, 1996). Furthermore, coordination and *interaction with the government* appears to be another crucial advantage for securing financial resources but also for getting access to the market (Li and Atuahene-Gima, 2002; Saxenian and Quan, 2005). Several other studies show the importance of *strategic swiftness and flexibility* (Meyer and Peng, 2005, Tan, 2005, Yam, Guan, Pun and Tang, 2004). Important is opportunity recognition, customer involvement, and localization. In terms of internal capabilities, the role of the *founder* remains significant, both in terms of experience and social connections (Batjargal, 2007; Peng, 2003). However, *technical capacity* cannot be overlooked either; especially the absorptive capacity of the firm for (foreign) technology (Wan, 2005).

In sum, antecedents to innovative capabilities in our definition are those organizational processes that provide resources (originating in individual, firm or network) to the firm that can give a potential competitive advantage in successfully developing and commercializing new products and services. The previous discussion of potential antecedents provides a potential set of specific and identifiable processes that can be usefully employed to develop empirical indicators. However, the factors presented here are a range of potential antecedents but is by no means an exhaustive list.

3.5 Institutions and capabilities

3.5.1 Institutional structuring of capabilities

The viability and success of a capability is contingent on the institutional context, as argued in Chapter 1. Any capability developed is to a large extent influenced by the specific arrangements in the economic context of the firm. Combining insights from institutional analysis with the work on organizational capabilities provides insights into the mechanisms that link institutional regimes and capabilities.

The comparative business system approach has argued how institutions governing capital, labour, product markets, and the public science system crucially affect the development of capabilities (e.g. Whitley, 2002; Casper and Whitley, 2004; Whitley, 2003). More specifically, Whitley (2002) has discussed how the strength of business associations and involvement with public training systems, the organization of the financial system and the public science system crucially affect the development of innovative capabilities. A similar reasoning can be found in the historical analyses of Lazonick (2007) on the social conditions of innovative enterprise. Lazonick argued with both historical examples from Europe and US (Lazonick, 2007) and contemporary examples from China (Lu and Lazonick, 2001) that innovative enterprise depends on organizing strategizing and financing, which are all crucially affected by the societal institutions that govern capital, labour and knowledge. Tylecote and Visintin (2008) recently put emphasis on the role of finance and corporate governance in explaining technological advantages of nations.

The link to the micro-level is analysed in the conceptual work of Whitley (2003) and Hage (2003), and the empirical work on Italian textile districts (Locke, 1995) and European biotechnology (Casper and Murray, 2003), career networks of biotechnology clusters (Casper and Murray, 2005). A good example is the recent study of Casper and Whitley (2004) that explains why platform biotechnology and ERP have been relatively more successful industries in Germany, whereas therapeutics and standard software industries are successful in England. The study suggests that the coordinated market economy of Germany, with its large firms in networks of powerful trade and industry associations and labour organizations support competence enhancing innovation strategies. The institutional arrangements supported industries where more complex organizations are effective, as is the case in ERP and platform biotechnology. The liberal market economy of England, on the other hand, with largely deregulated financial and labour markets and overall weak power of collective actors supported competence destroying innovation strategies. These institutional arrangements were supportive of entrepreneurial firms that focus on radical innovations, such as standard software and therapeutics.

In short, institutions support or constrain the development of capabilities for innovative activities (Mowery and Nelson, 1999; Hall and Soskice, 2001). To extend

the ideas from comparative institutional studies and the institutional structuring of capabilities to China, we need to consider that China is a transition economy with as a key feature *institutional change* (see working theory Chapter 1). Although the analyses of Whitley (2007), Coriat and Weinstein (2002), Sorge (2006) and more recently Aoki (2008) start to account for institutional change, this is limited to incremental institutional changes. The situation in China is different in two ways: rapid institutional transformation in which two – often-conflicting – institutional regimes co-exist: socialist – and market institutions (Qian, 2000). Next to that, there is institutional diversity within the national economy as a result of the decentralized nature of government in China (Krug and Hendrischke, 2008). The comparative institutional approaches have not yet started to incorporate such institutional set up. Before considering the features of a transition economy, first a note on institutions.

3.5.2 A note on institutions

Our assumption about institutions is that pragmatic agents construct institutions to cope with various problems under the specific circumstances of the time and context (Whitley, 1999; Sorge, 2006). Institutions thus are socially constructed and they function according to what meaning different groups of dominant actors attribute to them in specific environments and situations (Sorge, 2006). Instead of economic interpretations such as North's (1990) 'rules of the game' and Williamson's (1985) 'governance of transactions', this thesis employs an empirically more workable definition: Institutions constrain the distribution and allocation of critical resources and influence how firms have differential access to these critical resources, such as labour, capital and knowledge (Coriat and Weinstein, 2002; Hollingsworth and Boyer, 1997; Whitley, 2007).

I do not adopt a deterministic or static view of institutions. The comparative institutional approach has been criticized for being too deterministic and static (see for example Deeg and Jackson, 2007 and Lundvall, 1999). However, comparative institutional studies single out and make explicit several of the crucial institutional mechanisms underlying the organization and coordination of economic activities. This usually translates in ideal-typical representations of socially complex realities. These 'simplifications' indicate which societal institutions govern economic behaviour in what way in a particular environment (usually national, but also sectoral or regional). This merely means that such institutions 'crucially affect' and not determine behaviour (cf. Hamilton, 2006). Moreover, they propose a set of 'solutions' in terms of strategies, capabilities, innovative activities, etc. that are more likely and more credible to be developed in the specific environment. Perhaps the best way to view institutions is to assert that they create regularities (Coriat and Weinstein, 2002).

3.6 Institutional regimes in China

3.6.1 Institutional features of transition economies

Strategic decisions are not straightforward when the rules of the games are being re-written. The business environment of a transition economy is different from stable environments such as the US and Western Europe. A North-like understanding of institutional transition is 'fundamental and comprehensive changes introduced to the formal and informal rules of the game that affect organizations as players' (Peng, 2003, p. 275). Institutional transition fundamentally changes in who provides what kinds of resources and what kinds of constraints that limit agents' opportunism. Institutional transitions in emerging economies are qualitatively different (Peng, 2003). Whereas some countries used a big bang approach changing overnight from central planning to market economies – as in Russia and Eastern European economies – others have taken a more gradual approach, e.g. China and Vietnam. The former focused on central state level policy initiatives like sweeping movements of liberalization and privatization in the vain hope that firms will 'automatically' adapt and that market forces would emerge.

The first 'type' of transition can be illustrated by the experiences of Eastern European economies in the 1990s. The transformation of 1989-1990 has abolished the previous 'rules of the game' governing economic action yet new rules have not yet taken their place (Whitley and Czaban, 1998). Roth and Kostova (2003) show in their study of 22 countries in Central and Eastern Europe and the Newly Independent States that there are two elements in these countries institutional upheaval: 'institutional imperfection', or the gap between desired and existing institutions, and 'institutional baggage', or the legacy of state socialism that is still ingrained and pervasive in current institutional arrangements. State socialism has left the countries with a) a distrust of formal institutions that regulate relationships between social and economic actors; b) an absence of intermediary organizations that are able to mobilize commitments between individuals and the state; and c) vertical dependence of the state (Whitley, Henderson, Czaban, and Lengyel, 1996). So, it is unclear who the key actors are whose interests and actions have to be taken into account in making strategic decisions; increasing uncertainty instead of reducing it (Czaban and Whitley, 2000).

The second 'type' of transition is exemplified by China. The process of transformation is qualitatively different from the Eastern European one. One of the best analytic descriptions of China's transformation up to 1999 is given by Qian (2000). According to him there are two stages in which China's transformation evolved. The first stage (1979-1993) involved an incremental reform of the central plan and allowed the emergence of a market in resource allocation. The government was reformed through regional decentralization and the emergence of non-state – though mostly local government – enterprises. The second stage (after 1994) involved

the construction of market supporting institutions, while retaining the old institutions. The tax system was reformed resulting in a dual track system, state-owned enterprises were restructured and privatized and the government bureaucracy was further downsized (e.g. decreasing number of committees and ministries). In this process, economic reform did not involve democratization and liberalization proceeded slowly, just as privatization.

As a result of China's different approach to economic transition, we have to note two consequences of China's transition for innovation. On the one hand, the co-existence of two institutional systems affects the amount and quality of labour, capital and knowledge resources in the Chinese economy (i.e. underinvestment in resources problem). At the same time, the dismantling of the state socialist institutions and the emergence of and experimentation with market institutions causes considerable uncertainty for economic agents. On the other hand, local institutional variety causes wide differences in local resource bases and local governance mechanisms and increases horizontal competition of resources across localities. In general, changes in institutional regimes affect who specifies, monitors and controls the powers and responsibilities of private companies (i.e. uncertainty of governance of resources problem). Moreover, these changes affect who provides knowledge about technologies and markets, quality standards, labour – and capital market access. When institutional regimes change, as is the case in Eastern Europe and China, strategic agents, collective resources and incentives and constraints of firms change. The next sections will analyse how China's institutional change affects innovative capability development: underinvestment in resources and uncertainty of governance of resources.

3.6.2 Underinvestment in resources in China

An underinvestment in resources affects innovation and entrepreneurship in many ways. Entrepreneurship is affected by formal institutions such as the quality of commercial code and the strength of legal enforcement. Such institutions are mechanisms to reduce uncertainty caused by technology, competition or the market. One example is China's weak protection of intellectual property rights that depends on the strength of legal enforcement which hinders some innovating firms (Lau, Lu, Makino, Chen and Yeh, 2002, IFC, 2005). Private agents in China that are faced with a weak appropriability regime caused by a weak legal system, are expected to develop complementary assets. In the case of brand names, for instance, firms may have to rely more on status and collective reputation of the firm instead of legal protection. This suggests that private agents in China might actually have incentives to innovate their business model in order to mitigate the risks of imitation (cf. Teece, 2006).

Another example is an incomplete labour market. There is the general labour scarcity, i.e. availability of qualified labour as opposed to unqualified labour. Such shortage will lead to heavy competition on the factor market side. This will increase labour mobility and labour turnover in firms. Moreover, skill availability problems create uncertainty for employers as to the competences of the employee. An unpredictable and dynamic labour market leaves employers uncertain with respect to an employee's willingness to invest in one job or firm and the quality of their skills. How do employers assess their competences (Sako, 1992)? Strategies for attracting and keeping employees become crucial. One strategy is to have formal labour contracts, however, with incomplete and ill-functioning labour law enforcement, this does not provide good guarantees. Then, there are three alternatives: creating competence trust (cf. Sako, 1992); develop work arrangements that commit the employees to the firm; or use innovative corporate governance models to commit employees, all of which increase the risks for firms.

Since this study is concerned with explaining the underlying mechanisms at the firm level, it is useful to 'translate' the lack of resources to consequences at the firm level. The literature on the liability of newness is relevant here as helps to explain the consequences of a lack of resources *at the firm level*. Studies have suggested a negative consequence of 'newness' for the newly emerging private sector (Krug and Polos, 2004). Newness is often seen as a liability referring to new firm's resource poverty, lack of legitimacy, and weak ties to external actors provide them with reduced capacity when competing with established players (Aldrich and Fiol, 1994).

However, other studies have stressed the advantage of newness. New firms are innovative because their innovative efforts require the destruction of their existing competences and they are not hindered by ill-suited organizational routines and structures (Tushman and Anderson, 1986; Henderson & Clark, 1990). Barron, West and Hannan (1994) show that the hazard of mortality rises with age (controlling for size). Furthermore, the literature on first-mover advantages suggests that new early entrants may pre-empt resources, such as a customer base and hence benefit from newness (Lieberman and Montgomery, 1998). A lack of resources can have the following consequences at the firm level:

- Lack of business routine makes it difficult to locate talented employees, business agents such as potential co-operators and banks, and procedures to follow, copy or benchmark. On the one hand, the firm's inability to increase the level of management to ensure proper coordination and control from within the firm, which might hinder competence enhancement. On the other hand, the firm's inability to accumulate and develop technical skills necessary for innovative competence development might hinder attracting a variety of knowledge for

radical innovative activities. Such expertise can hardly be bought or learned through formal or informal education and training.

- Lack of a blueprint: there is no general understanding of how things should go right or wrong and where there is no past experience. In a business environment with few examples of successful firms or few firms in general that could serve as a benchmark, the only way to learn how to run a business is by trial and error, giving rise to risky decisions.
- Lack of knowledge about the business environment: no general knowledge about demand, prices, or income levels makes it difficult to do systematic research to calculate risks. In radically innovative sectors, where the risk of competence destruction is already considerable, this is less an issue than in incrementally innovating sectors where a lack of understanding market dynamics and procedures to analyse such dynamics, gives rise to additional risks. Especially in a newly emerging industry it is hard to predict which investments are worthwhile.
- Lack of legitimacy: refers to the lack of familiarity and credibility of new activities that constitute the fundamental basis of interaction. In an advanced economy setting, a lack of legitimacy can be interpreted in terms of not understanding fully the nature of the new venture and their conformity to established institutional rules. However, emerging economies usually lack such clearly established institutional rules. It is hard for firms to create such familiarity and credibility in a setting in which it is hard to predict even the overall rules of the game. Especially the unfamiliarity of the market with the new venture and the lack of skills of the customer lead to higher uncertainty of market acceptance.

3.6.3 Uncertainty about the governance of resources in China

The reforms since 1978 have resulted in local diversity and heterogeneity of local business environments (Krug and Hendrischke, 2008; Goodman, 1997; Wong, 2002). A local business environment here refers to a distinctive pattern of economic organization at the local level. Such distinctive pattern can only exist if there is considerable autonomy at the local level with respect to political and economic decisions. Local autonomy depends on a weak central state, which obviously is the case in China's economic and financial sector (Wong, 1992; World Bank 1995). The central government is in charge of designing and developing formal institutions and policies. On a national level, the result is often sectoral variation (Chen 2007). For instance, private firms have only been allowed to enter high-tech sectors only since the mid-1990s (Lau et al, 1998; Liu, 2004). However, there is a considerable degree of independence at the local level with regard to the implementation.

Local variety is caused by two factors. On the one hand, there are different degrees of independent decision-making at different local governments (Bird and

Chen, 1998). The extent of toleration and encouragement of collective semi-autonomous organisation and networks beyond part-state is one example. For instance, how strong is the central government's domination of organizations and associations. More specifically, the strength of interaction between local-central governments varies across localities. On the other hand, different local governments react differently to central policies and directives (Krug, 2004). Most important is a state agency's involvement in local private economic development. More specifically, what are the goals and strategies of local policies for state supported enterprises, foreign enterprises and non-governmental enterprises. There is considerable local and vertical variety in such strategies and goals.

One of the key insights about local variety in the recent literature is the concept of federalism, i.e. the interplay of different types and levels of firms and governments (Qian and Weingast, 1997). Fiscal reforms and partial decentralization of the tax system have led to a system of fiscal federalism (Qian, 2000; Qian and Weingast, 1997). Fiscal federalism in China refers to co-existence of a national tax system, with formal national legislation and tax farming linked to different layers of government, without formal legislation. This system shaped the privatization of assets and led to jurisdictional competition (Qian and Weingast, 1997; Walder, 1995).

Tax farming refers to tax contracts between lower and higher levels of government agencies and between economic actors and local government agencies (Krug, 2007, p. 129). The consequences for local economic development were far-reaching. In the system of tax farming, local governments are the claimants of marginal tax revenue (Oi, 1992; Wong, 1992). In other words, they keep the surplus tax, so they have incentives to increase revenues in their jurisdictions, i.e. help local entrepreneurs and spur economic development (Gregory, Tenev and Wagle, 2000; Oi, 1992; Walder 1995). As a result, localities offer a local resource base outside central control (Zhu, 2007). Generally, a system with local jurisdictions competing for business promotes local economic development (Dougherty and McGuckin, 2008).

Another consequence is the increased interaction between local business communities and local governments. The literature on local state corporatism (Oi, 1995 and Walder 1995) and state entrepreneurship (Krug and Hendrischke, 2008; Gold, Guthrie and Wank, 2002; Oi, 1995) has described how formal and informal negotiations have led to strategic alliances between local firms and local governments (Zhu, 2007). A feature of this system is the use of incentive contracts, also called crop-sharing contracts. These contracts reward managerial talent, mobilize financial and social capital and align government and economic agents' interests. One of the main benefits of this system is that it provides incentives to innovate (Stiglitz, 1999).

Generally, economic actors have the choice to do something alone or collectively. However, with ill-functioning markets and shrinking coordination of state socialist

institutions as a result of dismantling the state socialist economy, private cooperation offers higher rent (Ostrom, 1990; Krug, 2007). The alliance of economic – and government actors in networks has the clear purpose of pursuing and developing economic interest, i.e. they are business networks (Hendrischke, 2004, 2007). The actors in these networks are domestic firms and local governments but also foreign investors. Foreign investors are not only carriers of FDI but become part of the local business environment. Cooperation with local institutions and the ability to manage local knowledge in combination with foreign technology, management skills and capital is crucial for foreign firms (Child and Yan, 2003; Peng and Luo, 2000).

Considering the importance of business networks, it is useful to outline the main functions of Chinese business networks (outlined by Krug and Hendrischke, 2007). First, they help to overcome resource constraints. Given limited expertise, nobody to imitate, to copy, liability of newness, and no collective memory, i.e. a general underinvestment in resources, firms need to rely on skills outside the firm, such as the formal education system, the Party nomenclature (Nee, 2000) or business networks. Second, networks help to overcome institutional weakness (Peng and Luo, 2000; Wank, 1996; Xin and Pearce, 1996). Third, networks can help to overcome the problem of underinvestment in resources. Networks can function as a collective resource, i.e. a reduction of the relational risk in business deals. Individual actors will invest in networks as the actor expects to produce a benefit that it can appropriate. Networks are a social mechanisms for coordinating economic activities in which 'mutual trust, affinity, norms of reciprocity and reputation limit moral hazard' (Krug, 2007, p. 134). Fourth, networks can fill the institutional vacuum caused by negotiation between economic actors and local governments in the search for suitable rules and regulations (Hendrischke, 2004; Oi 1995; Walder 1995).

In sum, critical resources are governed by a variety of actors and it is unclear who is governing exactly what. The role of the national government is relatively small as systems like fiscal federalism and revenue sharing contracts decentralize decision making power to local governments and business communities. Moreover, public-private partnerships and collusion of interests between local governments and private business decrease the transparency of governance. The economic realm is occupied by informal business networks with specific informally agreed upon rules of enforcement.

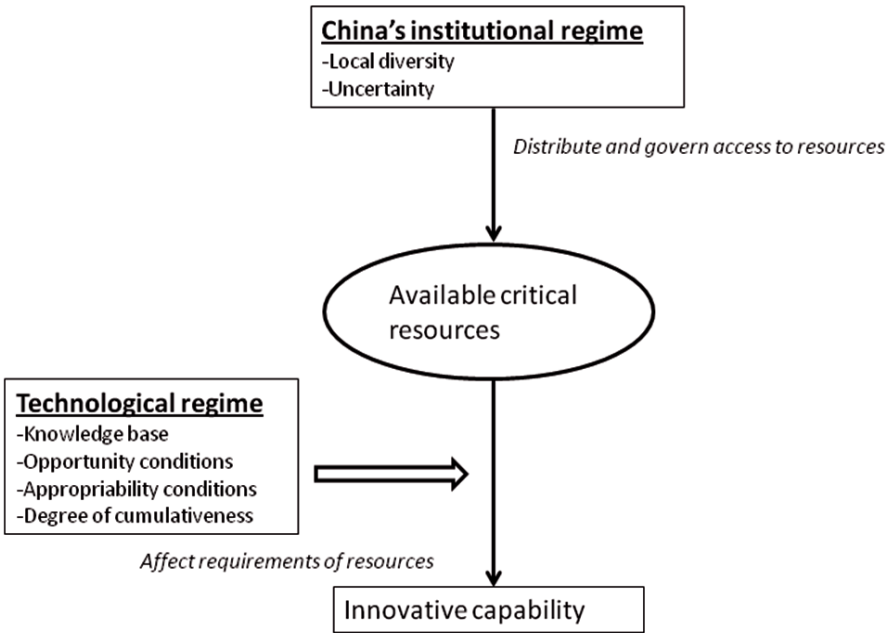
3.7 Summary and goals

In order to find an answer to the research problem and facilitate the empirical study, we have selected criteria to distinguish innovations, singled out antecedents of successful innovation and identified the main features of capabilities. Moreover, we explained how institutional arrangements can facilitate or constrain the development of particular innovative capabilities, while singling out several specific features of

China's institutional conditions. In particular, we identified institutional constraints on innovation, namely underinvestment in resources and uncertainty of governance of those resources (i.e. availability and use of resources, Chapter 1). Combined with the sectoral (technical, market) constraints identified in Chapter 2, innovation in China requires capabilities that manage technical, market and institutional constraints. **Figure 3.1** provides a graphic representation of the working theory.

The following intellectual goals can be singled out for the empirical study. The study starts with *setting the institutional frame* for innovation by analysing the features of the key institutions that govern and coordinate access and distribution for critical resources for the software sectors. In particular, the study needs to identify the consequences of institutional transition at the local level. Subsequently, the core of the study proceeds to analyse *underlying firm-level mechanisms* that explain the development of innovative capabilities of Chinese private entrepreneurs in that institutional frame. More specifically, the analysis aims to: (1) identify and explain innovative behaviour of Chinese private software firms; (2) identify and analyse sectoral – and institutional constraints on innovation and (3) analyse the development of innovative capabilities in response to those constraints. The next chapter will introduce the research setting.

Figure 3.1: Working theory for innovative capability development in China



Chapter 4

Economic prosperity, private business and three software sectors in Hangzhou

4.1 Introduction

The development of successful IT sectors – and software in particular – is regionally concentrated in China. The geographic distribution of innovating firms in the IT sectors is unequal: most of the best performing firms are located in the Yangtze River Delta, the Pearl River Delta and the Bohai Sea Rim (OECD, 2007). Furthermore, innovation is increasingly observed in domestic private enterprises (OECD, 2007; Lu, 2000; Zhou, 2008). Considering these two features of innovation in China, the selection of an appropriate location involves several criteria: the location needs to have strongly developed software sectors in a coastal region and private business as dominant form of organization in the software sector. Moreover, the location should be relatively prosperous compared to the national average as to function as a benchmark for other locations.

Beyond choosing a location for the research, the selection of a location reflects the selection of a local institutional frame. The 'population' is a variety of localities across China. The choice of location thus becomes important, as the fieldwork has a strong local bias and defines the scope of generalization. The selection of one location takes into consideration the intensive data collection efforts necessary for getting familiar with the local context in terms of language, local culture and developing local networks with research partners and business enterprises. Therefore a more detailed description of the research setting is warranted.

Whereas the majority of studies focuses on Beijing's Zhongguancun area or general overviews of the software sectors across Beijing, Shanghai, Nanjing, Dalian and Guangdong (e.g. Zhou, 2008; Tschang and Xue, 2005; IFC, 2005), we choose to study the software sectors in Zhejiang province, Hangzhou district. I used four criteria to select Hangzhou. First, the presence of a significant indigenous software industry. The software industry in Hangzhou is emerging successfully: 23.7 billion RMB in 2005 sales revenues of software products[9], 300 million dollars software product exports (Hangzhou Statistics Online, 2008). Software development, as I will show in this chapter is predominantly local and indigenous, i.e. not focused on outsourcing or sales. Therefore, the setting allows studying the emerging indigenous software sectors

[9] Note that this is the majority of the Zhejiang province total of 25,1 billion RMB.

and its capabilities. Second, the private firm as a dominant form of economic coordination and organization. Hangzhou is one of the centres for China's booming private sector. The significant share (95%) of enterprises of other types of ownership, i.e. non-governmental enterprises and 90% contribution to gross industrial output of the city, illustrate this point (Hangzhou Statistics Online, 2008).

Third, the success of the locality in terms of economic prosperity and business prospects. The latter is important because then the locality is more likely to function as a benchmark for other localities and thus enhances the generalizability of this study. Hangzhou is the capital of Zhejiang Province, a south-east coastal province. At the forefront of economic development, it offers one of the best business climates in China (e.g. World Bank, 2006). Fourth, presence of all three software sectors. Hangzhou's software industry is structured as follows: standard software (33%), enterprise software (32%), newly emerging middleware (18%, but especially growing fast last 2 years, i.e. many new firms are not included in CSIA yet) and others (18%).

This chapter will elaborate on these four features of Hangzhou by discussing the economic prosperity of Hangzhou, industrial structure, the role of the private sector in the local economy and software sectors.

4.2 Success and economic prosperity

Hangzhou is the capital of Zhejiang Province, a south-east coastal province. At the forefront of economic development, Hangzhou has been praised for offering the best business climate in China (World Bank, 2006). As China's 4th largest exporter, it accounts for almost half of China's trade surplus. The industrial and commercial focus is on light industries, such as IT, tourism, textiles and trade. Zhejiang is home to several Chinese indigenous brands such as Wahaha soft drinks and Alibaba's e-commerce model. Hangzhou, though relatively unknown outside China for its prosperous economic development, is part of the rich and dynamic Shanghai-Nanjing-Hangzhou triangle which account for over 20% of national GDP. It has 6.5 million inhabitants, a mid-sized city in China, with a total GDP of 340 billion RMB or 51,000 RMB per capita in 2006 (cf. Zhejiang Province: 1,350 billion RMB and 29,000 RMB respectively). GDP growth since 1978 is on average 19% per year; the lowest growth being 7% in 1982 and the highest growth being 46% in 1993.

Hangzhou is prosperous and that shows in the relatively high GDP per capita, annual average income per capita and living expenditures per capita. **Table 4.1** (next page) compares Hangzhou on these indicators with the national averages. Over the period 1990-2006, Hangzhou's per capita GDP has not only increased from 3,310 RMB to 51,878 RMB, it also has grown from two times the national average to three times in 2006. Annual gross income has increased tenfold and in 2006 is twice the national average. However, the living expenditures have also risen significantly and

are also almost twice the national average. All in all, Hangzhou's is surpassing the national average economic growth indicators on all fronts and can be considered a rich and prosperous city.

Table 4.1: Hangzhou's prosperity compared (RMB)

	GDP per capita		Annual income		Living expenditures	
Year	*Hangzhou*	*China*	*Hangzhou*	*China*	*Hangzhou*	*China*
1990	3,310	1,644	1,999	1,510	1,685	1,279
1995	12,797	5,046	9,121	4,283	5,559	3,538
2000	22,342	7,858	9,709	6,280	7,790	4,998
2005	44,853	14,103	18,762	10,493	13,438	7,943
2006	51,878	16,084	21,367	11,759	14,472	8,697

Source: Hangzhou and China Statistical Yearbooks Online, 2008

4.3 Industrial structure: towards tertiary industries

Hangzhou has a strong foreign trade and investment orientation, high proportion of the population is educated – benefits shared with Beijing and Shanghai – and is home to one of China's leading science and technology institutes, Zhejiang University. The local economy has a strong white-collar and tertiary industry character with a focus on science and education. These traits are the result of a long-standing academic tradition – with Zhejiang University centre-stage – and traditional focus on light industries, as argued in the previous section. In combination with recent advancements in physical and digital infrastructure, Hangzhou has become a centre for science and engineering in the fields of electronics, food stuffs and textile.

In official parlance, Hangzhou has five backbone industries – electronics and information, textiles and garments, machinery and manufacture, medicine and chemical engineering, and food and beverage. This reflects a focus on secondary and tertiary industries. Traditionally Hangzhou had, with limited resources and farmland, limited agricultural production capabilities, and an underdeveloped primary industry compared to the other industries. The secondary and tertiary industries were dominant in contribution to GDP and how agriculture was never really important to Hangzhou's development in terms of GDP. To compare, China's national GDP was still made up of primary industry for 12% in 2005, 18% in 1997 and 25% in 1989. Nevertheless, Hangzhou is the source for several famous agricultural products, like the Longjin green tea and silk production – biggest in China – and which provides input for the booming garment industry. The realized value added of the secondary and tertiary industries in 2006 was 174,199 billion RMB and 154,408 billion RMB. In the

secondary industries most output came from high-tech manufacturing enterprises, about 116,532 billion RMB, up by 45.6 percent over the previous year.

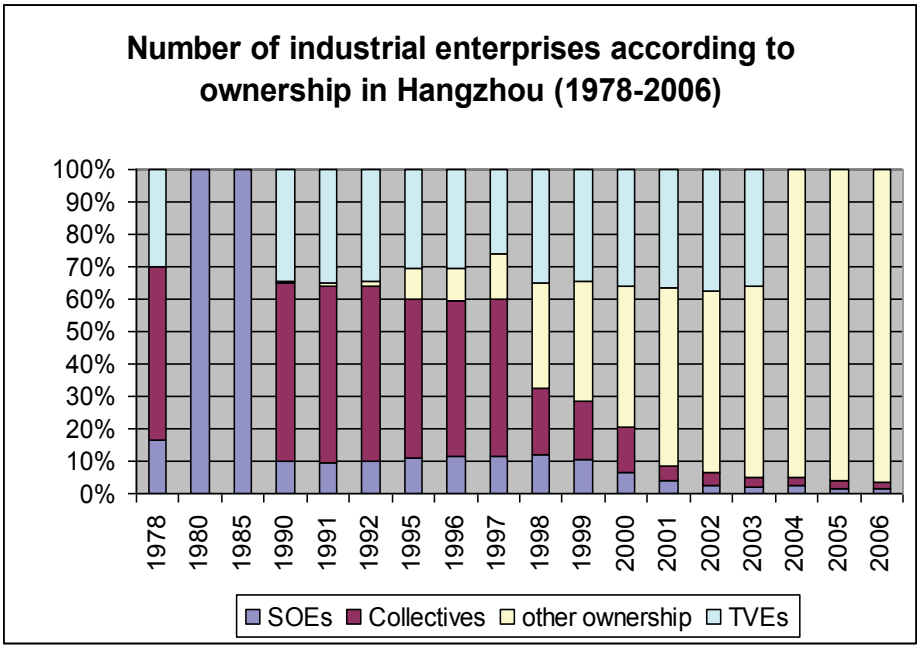
However, it is the tertiary industry that attracts our attention. The overall development sped up in all of the following sectors**:** Post and Telecommunications, Domestic Trade, Market of Production Means, Banking and Insurance, Real Estate, Tourism, and Information Industry**.** Hangzhou has a strong garment industry and the local government has been putting emphasis on design, manufacturing and trading women's wear, already reaching an output of 9 billion RMB in 2002 and establishing 260 brands of women's wear. Apart from these industries, Hangzhou also has a strong IT sector with international IT giants such as Microsoft. In 2006, Hangzhou's information industry had a total income of 128 billion RMB, of which the sales income of software products was over 23 billion RMB. It is noteworthy that the development of such IT sectors is strongly influenced by the presence of large firms, such as China Telecom, China Mobile, Alibaba and UTStarcom. Anecdotal evidence suggests that local firms enter into long-term customer and/or supplier relationships with large firms.

4.4 Changing ownership patterns: towards private entrepreneurship

The secondary and tertiary industries are dominated by private enterprises. Moreover, Hangzhou is one of the centres for China's booming private sector. The others being Nanjing/Suzhou, Shenzhen and Shanghai (China Statistical Yearbook Online, 2008). Whereas these and other cities' prosperity is driven by the proximity to Hong Kong (e.g. Shenzhen) and heavy inflow of investments from Hong Kong and Taiwanese entrepreneurs and investors (e.g. Nanjing/Suzhou), Zhejiang province developed more indigenously, relying on domestic key resources. At the end of the state socialist economy era, the province had not many large state-owned companies that drew resources and attention from the central government. Moreover, due to the lack of natural resources and limited farmland, the central government more or less 'neglected' this region. Zhejiang locals thus were relatively independent.

Figure 4.1 (next page) illustrates the significant share of enterprises of other types of ownership, i.e. non-governmental enterprises which includes all firms that are not exclusively owned by the state or majority foreign investment: TVEs, household enterprises, private enterprises, SOE spin-offs, publicly listed joint stock companies (Tsui, Bian and Cheng, 2006). The contribution of non-governmental enterprises to gross industrial output shows a similar pattern. Moreover, from the 5.1 million workers in Hangzhou, 1.9 million work in the private sector (Hangzhou Statistics Online, 2008). From these figures and the historical developments we can draw the conclusion that private enterprise is the dominant form of economic organization and coordination in Hangzhou.

Figure 4.1: shift toward private ownership



Source: Hangzhou Statistics Online, 2008.

Private business in Hangzhou clearly shows a sectoral concentration. The private sector employs in total 1.9 million people of the 5.1 million available workers. Most of these employees work in wholesale & trade (650,000) and manufacturing (640,000) sectors. Over 57% of the private enterprises are in wholesale and trading business with 31% of total registered capital and 35% of total employees. Manufacturing has only 14% of private enterprises but employs 34% of total employees and has 30% of registered capital. The IT sectors do not show up in the statistics as a separate category but belong to 'manufacturing' (for computer - and telecom hardware) and 'Information Transmission, computer services and software'. Furthermore, the interviews suggest that a part of the IT industries is recorded and registered under 'trade'. In general, tentative evidence based on these statistics and the interviews suggests that there is a strong sectoral concentration of the private sector in Hangzhou and that many private enterprises operate in IT sectors. **Table 4.2** (next page) summarizes the main features of the private sector according to sector in 2006.

Table 4.2: The sectoral concentration of Hangzhou's private businesses (2006)

Sectors	units	employees	registered capital (RMB)
Total	**384,763**	**1,891,113**	**19,674,630**
Wholesale and Retail Trade & Catering Services	218,650	658,976	6,117,439
Manufacturing	52,337	648,170	5,855,175
Service for the Residents and Other Service Sector	40,670	157,721	1,177,057
Accommodation and Catering	23,154	79,640	383,149
Transportation, Storage and Post	14,714	44,691	346,565
Renting and Business Service	10,664	87,296	1,085,760
Information Transmission, Computer Services and Software	6,169	56,647	630,465
Others	5,955	39,271	1,177,778
Farming	4,028	27,710	156,242
Construction	3,819	49,707	1,117,368
Culture, Sports and Entertainment	1,788	8,066	73,170
Real Estate	1,633	20,827	1,392,934
Mining and Quarrying	510	6,098	44,454
Health Care, Sports & Social Welfare	337	2,415	23,530
Electricity, Gas and Water	335	3,878	93,544

Source: Hangzhou Statistics Online, 2008.

4.5 Software sectors

4.5.1 Indigenous software

Graduates of Zhejiang University and other local universities started setting up software and other IT companies in the early 1990s. These entrepreneurial firms were complemented by larger companies like Eastcom and UTStarcom, which developed and manufactured telecommunications equipment. Hangzhou was the third city in China, after Beijing and Shanghai, to open connections to the Internet, in October 1995. At the end of the 1990s e-commerce firms started to move into the scene. The country's most successful dot-com – Alibaba - opened its doors in 1999 when it chose Hangzhou as its R&D centre and headquarters. The company is unique among Chinese Internet services in that it has few equals. Whereas Sina.com, Sohu.com, Netease.com, and Tom.com all compete for the same Chinese Internet consumers by providing similar services, Alibaba is unrivaled in China. Alibaba is different in that it focuses on Internet-only activity.

Hangzhou is home to several successful but less well-known software firms: Hangzhou Handsome, Hangzhou Sunyard, Singlee Software, Zheda Supcon, Zheda Qware, Zheda Lande, Zhejiang Dahua Information and Hangzhou Newgrand. These firms all have an annual turnover of RMB 100 million or more. Some of them even have a turnover of over RMB 500 million. These firms are part of an emerging group of successful indigenous software firms in Hangzhou. Hangzhou is the 4th software

national industry base in China after Beijing, Shenzhen and Shanghai. Moreover, it saw growth rates of over 40% in the last years[10].

The software industry in Hangzhou is emerging successfully: 23.7 billion RMB in 2005 sales revenues of software products (of the Zhejiang province total of 25.1 billion RMB), 300 million dollars software product exports (Hangzhou Government Online, 2007; Hangzhou Statistics Online, 2008). Compare these numbers to other sectors in Hangzhou and we can only conclude that the software business is taking up a substantial part of the industrial landscape and has a solid position: retail/wholesale 33.7 billion RMB; banking 25 billion RMB, real estate 21 billion RMB. The growth of the software industry is largely dependent on the presence of large firms such as China Mobile, China Telecom, Alibaba and UTStarcom. Many software entrepreneurs are former employees of Alibaba and UTStarcom.

The software sector has not only been growing in the past and has established itself among Hangzhou's sectors, it is also likely that it will continue to grow in the future. A census among entrepreneurs by the Hangzhou Statistics Office shows that the software sector (and information transmission and computer service sectors) had the highest expectation rate (178 points) of all industries, leaving industry, construction, retail, real estate and tourism (on average 124 points) far behind. Only social services were seen as another booming sector (162 points). Besides an indigenous software industry there is a foreign software market.

4.5.2 Foreign software firms

The software industry has attracted multinationals like Microsoft, Oracle, Adobe, IBM, Lucent, and Intel. They all have software and computing related R&D centers and joint ventures with local companies in China. More recently, Oracle and Siemens have expanded and upgraded their R&D facilities in China. Siemens for instance, opened a 3G software R&D centre in Hangzhou. More than 600 employees carry out research in solutions for 2.5G, 3G, Wimax and I-HSPA mobile telecommunication technologies as well as develop software platforms. Infosys has an R&D lab in Hangzhou hiring local software engineers. Motorola has acquired the respective set-top box assets of Zhejiang Dahua Digital Technology Company and Hangzhou ImageSilicon Technology Company. Intel Corporation opened a software innovation and support centre in 2007. Intel Capital, its global investment arm, approved an investment of US$10.5 million in a local industrial automation technology provider. The investment will help Zhejiang Supcon Technology Co, a subsidiary of Hangzhou-based Supcon Group, to further penetrate the market and enhance its ability to provide automation solutions worldwide. Acknowledging Hangzhou as an e-commerce centre, IBM, who

[10] http://www.tdctrade.com/alert/cba-e0504sp1.htm

established a branch office in 2005, announced in 2008 to set up their global e-commerce platform in Hangzhou. Yahoo! China was recently bought by Alibaba and now has its headquarters in Hangzhou as well. In sum, foreign software firms have set up R&D labs in Hangzhou and have engaged in local joint research.

4.5.3 Market structure

Though the statistics and information regarding the software industry is increasingly elaborate and consistent, it is hard to assess how many software firms exactly operate in Hangzhou. The official statistics of China Software Industry Association (CSIA), where every software firm is supposed to register in order operate legally mentions about 180 firms in Hangzhou in 2005. Only the CSIA provides information about products, assets and employees. However, there are indications that this list is incomplete. One paper on the software industry in Hangzhou mentions 324 software firms in July 2002. However, they do not mention how they constructed this list. Furthermore, the People's Daily speaks of 400 software firms in 2001. The official website of the Hangzhou government (and the local Statistics Bureau) even states 2000 software firms. Another government website, focused on the local IT industry, lists 281 software firms[11] in 2007. These numbers may diverge because of delay in registration, registration of groups of firms versus single firms and the difference between firms related to software (maybe even only sales) versus 'real' software firms, i.e. which are independent software developers. However, only the CSIA data has data on number of employees, registered capital and products. Following the same statistics, China has about 8000-10.000 registered software firms. Most of those are located in Beijing, Guangdong, Zhejiang or Shanghai. The majority – as far as can be derived from the data – is either private or foreign. A recent IFC (2005) study shows that the Chinese software market can be divided into three segments: products (51%), systems integration (33%) and IT services (16%). A handful of these firms are large but the majority, 95% is an SME[12].

Table 4.3: Zhejiang software market structure (RMB)

Sector	Employees	Average number of employees	Asset value range million	Average total assets million
Enterprise software	5-848	83 employees	0.5-45	6.6
Middleware	5-2,244	165 employees	0.5-40	11
Standard software	7-1,241	138 employees	0.5-100	10

Source: China Software Industry Association (2007)

[11] http://www.hangzhouit.gov.cn/cyfwpt/news/QYWZ_478/200512223294.aspx

[12] Unfortunately detailed comparative data for the sub sectors is not available

According to the CSIA there are 245 approved software firms in Zhejiang province and about 180 in Hangzhou, or about 75%. According to the president of the Zhejiang Software Industry Association over 90% of the software business is located within the Hangzhou locality. Total employment in these registered firms is 31,250 persons and a total asset value of 1.5 billion RMB. According to the CSIA, Hangzhou's software industry is structured as follows: standard software (33%), enterprise software (32%), newly emerging middleware (18%, but especially growing fast last 2 years, i.e. many new firms are not included in CSIA yet) and hardware/software combination (18%). According to the CSIA data most firms are SMEs (87% less than 200 employees) and have on average 139 employees and average total asset value of 9,300,000 RMB (see range and average for each sector in **Table 4.3**). The focus is on application software, systems integration services and embedded software and systems (e-commerce and network platform software, information system control). The main software markets in Hangzhou are presented in **Table 4.4**.

Table 4.4: Main software markets in Hangzhou

Industry	Examples
Banking, securities, funds and finance	Hangzhou Handsome, Hangzhou Sunyard, Singlee Software and Hangzhou Newgrand. The securities software produced by Handsome has a 46% share of the national market. The company's banking software has the second largest market share in China. Sing Lee Software, Hangzhou Sunyard System Engineering and Handsome Electronics accounted for 70% of the total market
Medicine and health	Major companies include the Hangzhou Chuangye Software. Its products are used in more than 300 hospitals on the mainland
Printing, dyeing and garment-making	Kaiyuan Computer Technology, Iechosoft Computer Technology, Honghua Digital Computer Technology
Taxation, industry and commerce, and public security	Major companies producing software for taxation and industrial and commercial administration systems include Hangzhou Jinshui, Hangzhou Hangjiahu, Hangzhou Speed
E-commerce	Alibaba, R&V, Kadang Net and Netsun are provide online platforms for consumers, business firms and local governments to interact, exchange information and close business deals.

4.6 Summary

The research setting for the empirical study is Hangzhou district. Hangzhou is one of the most prosperous regions of China in terms of GDP, income and wages. Hangzhou's government appears to work 'at arm's length', i.e. a non-intervening local government. Moreover, private firms are the dominant economic actors. The focus of the local development strategy is on innovation via high-tech zones and private entrepreneurship. The service and high-tech industries are the successfully developing

industries. More specifically, the three software sectors that are subject to this study have developed successfully in Hangzhou. In short, Hangzhou is an appropriate research setting for the purpose of this study. The next chapter will discuss the research methods and techniques of my empirical study.

Chapter 5

Research method and techniques

5.1 Introduction

The purpose of the study is to explain what kinds of innovative capability Chinese private entrepreneurs in the software sectors developed in response to what kinds of sectoral and institutional constraints in China's transition economy. The nature of the research problem and the analytical framework set several challenges for the design of an appropriate empirical study. First, institutional transformation by definition brings along complexity, uncertainty and instability. It involves profound changes in institutional architecture, key strategic actors and dominant logics of coordination and organization of economic activities. Second, the study needs to take into account and reconcile two levels of analysis for studying the software sectors: the institutional – and firm level. The empirical study will need to analyse both levels of analysis and identify crucial connections. Lastly, China's transition economy has specific research challenges. Whereas topics such as innovation and capabilities have been studied extensively in advanced economies, we cannot assume that the underlying mechanisms or even the understanding of these concepts is similar in China. In response to these challenges, a qualitative, inductive research approach is warranted. The study focuses on three newly emerging software sectors (Chapter 2) in one local institutional regime, Hangzhou (Chapter 4). In this chapter we will discuss the research techniques, data collection and analysis.

5.2 The approach in this study: two types of case studies

The empirical study rests on two types of *case studies* and follows a multiple case study design. The case study as a research method is one form of qualitative research[13]. In the broadest sense it refers to the in-depth study of a single instance of a social phenomenon. Case studies may help in both improving idiographic understanding of a particular case or form the basis for nomothetic theories[14]. "In general, case studies are the preferred strategy when 'how' and 'why' questions are being posed…and when the focus is on a contemporary phenomenon within some real-life context." (Yin, 2003:1, 6). Case studies are typically rich in data, preserve the narrative 'whole' (i.e. include the context), involve interpretative analysis, allow for the study of causal

[13] The other forms for instance being ethno-methodology, grounded theory, institutional ethnography, participatory action research, etc. (Babbie, 2004)

[14] Therefore, case studies are neither limited to theory-building nor to theory-testing

complexities, multilevel analysis, and often involve concept formation or modification (Babbie, 2004; Ragin, 1987).

Four key features of case study research can be singled out (Ragin, 1987). First, uncovering patterns of invariance and constant association beyond statistical probabilities as evidence for causal relationships. Second, case studies are relatively insensitive to sampling and sampling distributions, the variety of meaningful patterns is more important. Third, cases are seen as whole entities, not as collections of variables. It is the different conditions together that constitute a single situation or phenomenon. Last and one of the key points, case study research involves a rich dialogue between empirical data and ideas. Few simplifying assumptions are made which prevents restricted or constrained examination of the evidence. Referring back to the challenges outlined in the introduction of this chapter, the case study method is appropriate for the current study as the research question under investigation involves multiple levels of analysis, complex causal connections and aims to improve our understanding of underlying social mechanisms in a specific sectoral - and locally constrained research context. The nature of the research question of this study suggests that case studies are the preferred research strategy.

Two types of case study are used in this thesis:

(1) The first type of case study aims to *set the institutional frame* by identifying and analyzing the key institutions that provide and distribute critical resources for software development in Hangzhou. In particular: the role of the state, skill development and formal education, and the financial system. The case considered here is one locality in China, Hangzhou. The case study aims to capture the complexity of local institutions in terms of opportunities and restrictions. On the one hand, we need to identify those key factors that play a significant role in the dismantling the state socialist economy. On the other hand, we need to analyse the consequences of such dismantling as caused by these factors. The analysis sets the institutional frame for the investigation of innovative behaviour at the firm level.

(2) The second type of case study analyses *the underlying firm-level mechanisms* that explain the development of innovative capabilities of Chinese private entrepreneurs to fight off sectoral and institutional constraints. Referring back to the main research problem and Chapter 3, the goals of this case study are threefold: 1) analyse innovative behaviour of Chinese private firms; 2) identify and analyse sectoral – and institutional constraints on innovation and 3) identify and analyse the development of innovative capabilities in response to those constraints. Evidently, the aim is to identify patterns of behaviour. A *multiple-case study* is the most appropriate method to capture sectoral variety and patterns of innovative capability development.

A multiple-case study has the following distinguishing features: First, a cross-case research design focuses on finding patterns across a set of cases. Next, it enables a replication logic in which cases are a series of experiments that allow (dis)confirmation of inferences drawn from the others (Yin, 2003). Next, a key feature of interpreting cases in a cross-case analysis is the confrontation of the cases with concepts and theories as developed in Chapter 3 (Maeki, 1993). Therefore the multiple-case study does not follow a linear process of data collection and analysis. Last, there is no strict guiding principle for the number of cases. Multiple-case studies follow a saturation principle, i.e. no more new cases are added whenever a saturation point is reached. The saturation point is defined as that number of cases beyond which adding an additional case causes no significant change in the identified pattern. Concluding, the results are typically more generalizable and better grounded than single-case study designs (Graebner and Eisenhardt, 2004). Before discussing the data collection and analysis strategies I will describe the sampling strategy and the sample of firms in this study.

5.3 Sample of the multiple case study

We need to note certain sampling issues related to China's context. Beyond the problems associated with sampling for China-wide research, there are several problems associated with the sampling within smaller research settings, such as provinces and cities. What type of sample selection is appropriate? Considering the aim of this empirical study to compare three sectors, stratified sampling seems to be more appropriate than random sampling. The second issue is how to define the population. Although it is possible to obtain lists and directories of organizations to take samples, there are at least two problems. First, how up-to-date are these lists? Second, how independent are the lists? The costs of accessing respondents via intermediaries and state authorization make it already difficult to assess the characteristics of the population under consideration. Not paying attention to these issues might lead to 'convenience' sampling. Therefore, it is very important that a researcher understand the system in which he does his study and is aware of the different parties and interests (Roy, Walters, Luk, 2001). The representativeness of the sample is determined by the research problem, the analytical framework and it is the researcher that needs to assure representativeness in the field.

The selection criteria for firms in this study were as follows: (1) small or medium size (1-300 employees), (2) privately owned, (3) independent software developers, i.e. firms focused on software development rather than other businesses and (4) in one of the three software sectors. The size of the sample was not determined beforehand. The main criterion was the saturation criterion. This is neither a consensus-based cut-off point, as is usual in social science research, nor a convenience criterion but a

theoretical criterion. It means that past the saturation point, an additional case does not add much explanatory power. The classification of firms into the three sub sectors was relatively straightforward since firms often identify themselves as working in one of the three sectors. To ensure that each firm was classified correctly I also used three questions in the interview: 1) description of main products / services; 2) the firm's main competitive strategy; 3) the extent of customization.

The sample consists of 45 software firms in three distinct software sectors with an average age of 5.8 years (1995-2006), on average 75 employees (6-260) and, if making sales revenues, between 200,000 (Internet software) and 80 million RMB (large scale ERP project for government). Enterprise software is extensively customized software using platforms or modules. On average these firms are 6.6 years old (1995-2006) and employ 73 employees (6-200). Standard application based software is written for large homogenous markets. These firms are on average 5.6 years old (1996-2006) and employ 46 people (28-100). Middleware is a new sector focusing on interface technologies that link basic architecture of digital communication networks to standard application software, thereby coordinating various technologies. These firms are on average the youngest in the sample with 5.4 years (1995-2006) but employ the most people, 95 (8-260).

Table 5.1: sample versus population **size** characteristics

	Population	Sample (45)
Standard software	Mean: 65; sd*: 53	Mean: 46; sd: 27
Middleware	Mean: 75; sd: 61	Mean: 95; sd: 85
Enterprise software	Mean: 62; sd: 79	Mean: 73; sd: 62
All	*Mean: 67; sd: 64*	*Mean: 71; sd: 58*

**sd = standard deviation*

The only way to show how representative this sample is for the population of software firms in Hangzhou is by comparing the size characteristics. A lack of systematic data for the population of software firms in Hangzhou is one of the data restrictions researchers in China have to deal with. According to the CSIA, Hangzhou's software industry is structured as follows: standard software (33%), enterprise software (32%), newly emerging middleware (18%), and hardware/software combinations (18%). Especially the middleware sector is growing fast last 2 years and many new firms are not included in CSIA yet[15]. Most firms are SMEs (87% less than 200 employees) and these have on average 67 employees and average total asset value of 9.300.000 RMB. **Table 5.1** compares the size characteristics of our sample with the population of software SMEs Hangzhou. The results suggest that the sample is representative for

Hangzhou, at least in terms of size, as the averages and standard deviations do not show a different pattern.

We note here two sample selection biases. The first is that the study is limited to successful firms, i.e. firms that still operate and have products on a market. The consequence is that we cannot compare our findings with firms that have not been successful in innovation. Therefore we cannot check if firms that are not successful innovators indeed lack the capabilities we identify. Hence we cannot know if the capabilities we identify are all necessary and sufficient for successful innovation. However, we can at least assume that these capabilities are sufficient for innovation if we find systematic patterns across the sectors. The second bias is that access to these enterprises was sought via Zhejiang University, the University Science Park and directly via the authors' personal networks. We take note of the fact that this might not be considered representative by the usual social-scientific standards of Western research practice because all mediators were likely to have applied their own filters to the sample. We could run the risk that our mediators have selected the most successful firms in terms of innovation. This is a context specific research limitation, faced by every researcher in China doing in-depth field interviews (cf. Krug, 2004). However, we believe that we have mitigated the majority of the selection biases by not using every 'suggested' firm, doing background research on the selected firm, developing a trust-based relationship with local mediators and only surveying firms that fit our theoretical criteria. Altogether, we suggest that the combined information is rich and unique and allows us to learn about firm-level innovation in China.

5.4 Data collection

As discussed in section 2, this study has two types of case studies. The first case study sets the institutional frame by analyzing the institutional arrangements in Hangzhou. The second case study is a multiple case study of Chinese software firms in three sectors in order to analyse the development of innovative capabilities in response to sectoral and institutional constraints. The data requirements and strategies for these two case studies are different. Before we go into detail with the data collection strategy, it is useful to note several specific aspects of research design in the Chinese context that need to be considered.

The following aspects in *research design* have to be reckoned with: measurement equivalence, language issues, interpretation of concepts (Malhotra, Agarwal, 1996). Do Likert-scales have the same meaning for Chinese? Open questions might lead to more reliable answers. Do concepts such as 'warranties' and 'legal securities' have the same meaning for Chinese? Could you ask Chinese to answer hypothetical questions?

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[15] Interview with the president of Zhejiang Software Industry Association, September 26, 2007

Bond and Hwang (1986) show that Chinese have problems with hypothetical situations. Shenkar (1994) for instance shows that managers often have to interact with state officials, which makes their 'autonomous' management decisions, less autonomous. Finally, translation of questions to the Chinese language is a very important step in the research design. Fortunately, established back-translation procedures make things manageable (Brislin, 1970). In all cases it is important to know who your respondents or interview candidates are and what the system is in which they live and work (Krug, 2004). Considering topic sensitivity, social acquiescence and researcher response bias is especially important when a researcher carries out the research himself.

5.4.1 Documentary data and interview data for the Hangzhou case study

A variety of sources is necessary to reconstruct the institutional influences at the local level in Hangzhou. The starting point of the study was the Hangzhou Statistical Yearbook that provides the most comprehensive data. However, there are limitations to the use of such secondary data published by the government (Roy, Walters, Luk, 2001). For instance, data sources most often provide only data on the macro-level. Even though the state has recognized the crucial role of good information for policy decisions, and has improved the statistical system, there are many problems with the data that could lead to inferential errors. Data collection by the state is often inconsistent among the different bureaus, provinces and cities. Furthermore, data is often inaccurate, obsolesce and subjective – in the sense that local party officials want to sketch a more positive picture of their locality for the central government. Therefore, when using secondary data, incompleteness and inaccurateness of the data needs to be considered.

Next to that, the government still has strong control over data. How to get access to the relevant statistics? Even though the opening-up of the economy led to more open research and sharing of information, it is often unclear what is restricted information and what types of research are permitted. Cooperation with local researchers or institutions is crucial. However, problems of self-censorship, sanction exposure, Western researcher's limited access to information, tradition to provide macro-level data, lack of control over data collection activities and lack of transparency are not be underestimated. Therefore, the political issues surrounding organization research are substantial and need to be made explicit. Even in the case of numerical research involving statistics, we cannot assume the quality and reliability of the data. Therefore, limitations of secondary data necessitate researchers to visit China and assure the quality and reliability of data collection methods and representativeness. Therefore, after an initial assessment of the data available in the Statistical Yearbook, significant additional data collection efforts were necessary.

The data set that forms the basis for the case study on Hangzhou is based on in total six different sources. The first is the Hangzhou Statistical Yearbook since 2000 available online. The second is a collection of news items in English and Chinese from news websites. Third, historical background information from a variety of historical sources on Zhejiang's and Hangzhou's history. Fourth, general information websites from the Hangzhou government. Furthermore, especially detailed information on human resources was missing in the preceding data sources. Therefore, my fifth source is based on new data from a unique database of Zhejiang University alumni and supplemented with firm level data on human resource issues in Hangzhou. The former is obtained with the help of a personal contact in the Zhejiang University Career Development Centre. The firm-level interview data will be described in more detail in the next section. Summarizing, the data for analyzing Hangzhou's institutional frame is obtained from documentary data sources supplemented with interviews.

5.4.2 Firm-level background – and interview data for the multiple case study

The multiple case study is based on firm-level in-depth interviews and triangulated with background information. Prior and after the firm interviews I collected data on the firms from a variety of sources. First, the firm's website, usually in Chinese, provides relatively detailed information on history of the firm, products, news announcements and partnerships with other firms, universities or government agencies. Second, local investment firms provide detailed information on firms and news for selected industries. A good example is the commercial private local Hangzhou Hexun website that offers up-to-date local business information in Chinese. Next, together with a group of graduate students from Zhejiang University we did a news search in local and national news websites to supplement the cases. Fourth, we contacted the Zhejiang Software Industry Association and obtained a list of software firms in Hangzhou with product, personnel size, asset value and website information. These sources together form part of each case study.

However, the main data source was the in-depth interview in the firms. In a society characterised by a large role of informal institutions, as opposed to formal rules and regulations, an informal interview with considerable time to 'dig-up' the story is preferred. The interviews also allowed the respondents to express their understanding in their own terms which allows unambiguous communication and establishes communicative validity. The semi-structured interviews were done with either founders or senior managers. All interviewees have a background in engineering with at least a Bachelor's degree. Although there may be a bias in the answers as a result of the types of informants, we believe that the information is reliable due to the use of alternative sources of information, comparison of answers to equivalent questions and discussion during the interviews.

Table 5.2: Interview questions

Topic	Number of questions	Questions in interview
(I) Innovation & capabilities	*31*	*1-26*
Strategy	3	1,2,5
Innovation process	9	8-16, 26
External partners	11	17a-17k
HRM	8	18-25
(II) Sectoral constraints	*15*	*27-41*
Competition	5	27-31
Customers	5	32-36
Technology	5	37-41
(III) Institutional constraints	*16*	*42-57*
Uncertainty	12	42-53
Lack of resources	4 plus 3 in (I)	54-57
Total	*61*	*1-58*

5.4.3 Designing interview questions

The interview covers the three topics of this study: innovative capabilities, sectoral constraints and institutional constraints. I will discuss each of these general themes and how they are represented in the interview schedule (**Table 5.2**). The questions for the interview were developed in close connection to the research problem and the analytical guide developed in Chapter 3. An English and Chinese version of the interview protocol can be found in the **Appendix**.

(I) Innovation and innovative capabilities

Innovation is here understood as a first attempt to carry out an idea for a new product or process into practice involving new knowledge or new combinations of existing knowledge. In this empirical study we investigated different aspects of innovation (Chapter 3): type, characteristics and systemic features. First, we singled out 5 types of innovation: new product and methods of production, new ways of organizing the value chain, opening new markets for goods and services and new ways to organize business. A set of questions (8-16, 26) deals with the innovation process and focuses on several examples of innovation, chosen by the entrepreneur. By using real-life examples the discussion is more focused and also allowed us to get a better understanding of the type of innovation process. Second, innovations can be incremental or radical. The assessment of innovations considered two aspects: substantially different core technology (as compared to the technological trajectory in the industry) and substantially different product/services for customers relative to existing products/services in the industry. This is captured in the interviews with a series of

questions about the innovation process (questions 8-16), technological developments in the industry (questions 37-41) and customers/market (question 32-36). Third, innovations can differ in their systemic features, i.e. from systemic or modular to stand-alone. The assessment of innovations considered two aspects: switching costs and modularity, i.e. the interdependence of the innovation with other parts of organizing the economic activities done by the firm. A combination of questions about the innovation process, customers (32-36) and technology (37-41) was employed to capture this characteristic of innovation.

Table 5.3: 16 categories of question topics about innovation and capabilities

Categories – developed economies literature	Categories – China literature
Acquisition of new technology	Formal/informal external partners
External partners for new knowledge	Interaction with government
Expert employees with diverse backgrounds	Strategic swiftness/opportunism
Coordination of innovation networks	Founder network
Access to finance	Technical capacity
Reputation in knowledge markets	
Technical capacity	
Flexible strategy	
CEO experience in entrepreneurship and innovation	
Firm-specific expertise	
Innovation orientation	

The questions about innovative capabilities started with a survey of capabilities and antecedents in the literature. Antecedents to innovative capabilities are those organizational processes that provide resources (originating in individual, firm or network level) to the firm that can give a potential competitive advantage in successfully developing and commercializing new products and services. In total 212 unique antecedents are identified in the literature. Many of these antecedents were overlapping or related to the same topic. Therefore, these 212 antecedents were categorised according to topics. From these 212 potential antecedents 16 categories emerged (**Table 5.3**). The criteria for reducing the antecedents to these categories are: 1) theoretically meaningful categories that match the conceptual definition of innovative capability; 2) deletion of overlapping or strongly related antecedents (e.g. business ties, business group, cooperation with university were combined into 'external partner'); 3) deletion of antecedents that were only mentioned once. However, most important was the confrontation of the set of antecedents with the conceptual literature and the research problem under investigation in this study. These 16 categories formed the basis for question development. The design of questions was eventually determined by the fit with the research problem and the working theory.

(II) Sectoral constraints

The questions on sectoral constraints were based on ideas and studies from the sectoral innovation system literature. This literature argues (Chapter 2) argues that factors such as competition, market acceptance and technological characteristics best describe and distinguish sectors. These technological regimes have specific technical and market features. Sources for questions about these topics were, among others, the studies by Malerba (2004), Casper and Whitley (2004), Edquist (1997) on systems of innovation. Especially the ideas of the sectoral innovation system, as outlined in Chapter 2, proved useful for designing questions. This literature measures the characteristics of technological regimes in terms of: Opportunity conditions, appropriability conditions, (changes in) the knowledge base, and degree of cumulativeness (e.g. Malerba, Breschi and Orsenigo, 2000; Malerba and Orsenigo, 1993; Parker and Tamaschke, 2005).

The characteristics of the knowledge base can be understood in terms of specificity, tacitness, complementarities and independence of knowledge (Dosi, 1988). However, instead of focusing on the technical details of certain technologies and their specific knowledge bases, the focus is on how *changes in the knowledge base* pose constraints. The research problem is concerned with innovation, defined as introductions of new knowledge or new combinations of existing knowledge (Chapter 2). Therefore, we are more interested in how changes in the knowledge base pose constraints in contrast to the specifics of the current knowledge base. These four features form the basis for designing questions about sectoral constraints.

(III) Institutional constraints within Hangzhou

The questions on institutional constraints focused on the lack of resources and the uncertainty caused by the governance problem of who is providing what kind constraints on the use of these resources. Two sets of questions were developed.

The first set of questions is related to institutional uncertainty. The development started with a literature survey of the consequences of institutional transformation with a focus on constraints. This survey included empirical and conceptual studies from management, economics, sociology and Asia/China-specific academic journals. Here we will shortly summarize them: (1) Unpredictability of institutional change; (2) Limited legitimacy of private firms; (3) Competing levels of government; (4) Decentralization of government leading to ambivalent rules; (5) Hybrid institutions; (6) Weak IPR protection; (7) Lack of transparency (e.g. Manolova and Yan, 2002; Krug, 2004; Meyer and Peng, 2005; Tan, 2005; Qian, 2000). The questions were developed in comparison to other studies in transition economies, like Krug (2004).

The second set of questions is related to the lack of resources in the institutional environment (Chapter 3): (1) lack of business routines; (2) lack of a blueprint; (3) lack of knowledge about the business environment; (4) lack of legitimacy (Krug and Polos,

2004; Stinchcombe, 1965; Aldrich and Fiol, 1994). It must be noted that we rely on subjective measures of institutional constraints (cf. Krug and Hendrischke, 2008). Such a perceptual measure allows us to view the firm's environment from the perspective of the respondents instead from standardized or archival measures of environment (Tan, 2001). This is especially important since we are interested in how the uncertain institutional environment constrains strategic decisions of the managers. In the interview we used questions like 'Is it clear who the supervisory (administrative/legal) agent of your sector is?' or 'How dependent is your firm on state actions and policies?'**.** The next section describes how the interview protocol was translated and transformed into Chinese.

5.4.4 Designing and testing the Chinese interview protocol

After having developed the sets of questions for the main research topics, the questions were organized according to the following categories: strategy, innovation, external partners, organization of work, customers, competitors, technology and knowledge base, legal and administrative environment, new industry, challenges. The interview consists of mostly open-ended questions and included four types of questions: essential questions, extra questions (more or less equivalent to the essential questions, to control for reliability and wording), throw-away questions (to develop rapport, set pace, and change focus), and probing questions.

Next, we discussed the questions with China-experts. They have several decades of experience of research in China. These colleagues have focused on studying private entrepreneurship and institutional change. They were especially helpful in terms of adjusting the questions to the appropriate level and way of understanding of a Chinese entrepreneur. In order not to become too China-specific and keep the results of the study comparable and within the language of leading research, we consulted colleagues with expertise in innovation and capability research. They have long term experience doing fieldwork in different US American and Western-European economies on innovation and the development of capabilities. Their experience in designing interview questions and knowledge about the current ideas on innovation and capabilities proved useful in revising the interview schedule.

In the last step, I developed the Chinese language semi-structured interview protocol in cooperation with a team of Chinese graduate students from Zhejiang University. We started with the list of questions and started discussions about the questions, the question-order, wording and lay out to ensure that the concepts were clearly understood before translation. After the first translation, the protocol was tested in a pilot interview with two IT managers. During this pilot we checked for the following: topics, length, type of questions and overall structure. Moreover, we checked if all questions were included, if they elicit anticipated responses, if the

language level is meaningful, and if the interview motivates active participation in the discussion. We revised the protocol where appropriate to better fit the language and understanding of an IT professional. Following such intensive procedure, we believe the resulting interview protocol is more appropriate for gathering in-depth detailed interview data in a Chinese context (Krug and Polos, 2004). The Chinese version of the interview protocol can be found in the **Appendix**.

5.4.5 The interviews

In the period from February to June 2006 the author and a research team of Chinese graduate students interviewed software entrepreneurs in Hangzhou. The graduate students were all trained and sat-in at least one interview to get familiar with the procedure. The students all are fluent in English which facilitated communication with the author. The interviews were done in Chinese. The author – with basic Chinese language skills - was always present and the interviews were done in tandem. The questions were asked by the students whereas both researchers took notes. The author participated in discussions and asked follow up questions where necessary. The interviews were not allowed to be recorded. Therefore, both interviewers took detailed notes, discussed the notes directly after the interview and compared each other's notes.

During the interviews nondirective items to probe (sensitive) issues were used, for example, 'can you tell me more about that,' 'is there anything else that is important in relation to that,' or 'that is an interesting issue you raise, can you elaborate on that.' In addition, we had lists of examples of the concepts used in the interview protocol in case the interviewee required examples. The interviews on average took 1 hour and 15 minutes, even though one interview lasted over three hours.

As discussed before, multiple-case studies do not follow a linear process of data collection and analysis. After the first round of interviews I started analyzing and drafting the first ideas, conferring with colleagues and industry experts and presenting our initial ideas. After having drafted the first ideas I went back to the field to do return visits to some of the firms (11) and several more interviews with other entrepreneurs from September to November 2007. This allowed us to present and communicate some of our initial ideas to the entrepreneurs, ask additional focused questions on topics that proved worthwhile to pursue after the initial analysis and gather additional data to strengthen and refine the data until saturation was reached, i.e. adding more cases would not have changed the patterns in the data.

5. 5 Data analysis

The last decision in developing the research strategy for the empirical study involved the methods of analysis. The study analyses firm behaviour in an institutional frame. Therefore, the first case analysis involves setting the institutional frame of Hangzhou's

business environment. The documentary data supplemented with interview data is analysed according to the following factors: role of the state, human capital, private capital, and foreign investment. The analysis is based on a variety of macro-economic data and was supplemented with firm-level data on human capital development. Chapter 6 presents the results of this analysis in a case study of Hangzhou.

The second level of analysis involves the interviews which lie at the core of this research. The general aim of the data analysis of the cases is to build on and move beyond the respondents' descriptions. For every firm we build individual case studies, synthesizing the interview data with archival, news and website data (Eisenhardt, 1989). A triangulation between interview data and archival data creates a richer and more reliable account. The individual case studies were written according to the main structure of the interview schedule (i.e. strategy, innovation, HRM, external partners, competition, customers, technology, institutional uncertainty and underinvestment in resources). At this stage similarities and differences across cases are noted but further analysis was left until completing all the cases to maintain the independence of the replication logic (Brown and Eisenhardt, 1997).

After finishing the individual cases we used cross-case analysis to identify patterns in the data across the cases. Cross-case analysis involves the search for similar constructs and relationships across multiple cases. The confrontation of the data with existing theoretical development is a crucial feature of cross-case analysis (Maeki, 1993). The identification of systematic features and confrontation of these with existing knowledge strengthens emerging ideas. As discussed before, the analysis involved two steps: first, an analysis of the first 30 cases, then back to the field for additional interviews and then a second analysis of all 45 cases. Basically, in the first step I examined pairs of cases on similarities and differences. As patterns begin to emerge, certain evidence may stand out as being in conflict with the patterns. Then we went back to China for more interviews and follow-ups interviews to confirm and/or correct the initial data in order to connect the evidence to the findings. If patterns emerge which match an empirically based pattern, "the results can help a case study to strengthen its internal validity" (Yin, 2003, p. 103).

The focus in the cross-case analysis is on (1) firm-level processes and activities that manipulate the firm's resource base in order to innovate and (2) sectoral - and institutional constraints that influence these processes. In particular, considering the three goals of this comparative case study, the focus was on identifying three sets of features and patterns.

The first goal was to identify patterns of innovative behaviour of Chinese private software firms. The analytical framework developed in Chapter 3 provides several

useful classification schemes. First, five types of innovation are singled out in the literature: new product and methods of production, new ways of organizing the value chain, opening new markets for goods and services and new ways to organize business. Next, the drivers or sources of innovation are: technology, market, government, enterprise. Next, radical versus incremental innovation. Last, stand-alone, modular and systemic innovation. The case analysis involves the identification of systematic features and patterns of these four characteristics of innovation. Chapter 7 presents the analysis of innovative behaviour of Chinese software entrepreneurs.

The second goal was to identify and analyse sectoral – and institutional constraints on innovation. The analytical framework in Chapters 2 and 3 provide the structure for analyzing the cases. Sectoral constraints are those constraints determined by the technological regimes in each sector investigated. The institutional constraints refer to uncertainty and underinvestment in resources. More specifically, the resources under consideration here are capital, labour and knowledge. The case analysis involves the identification of patterns in these two sets of constraints. Chapter 8 presents the results of the sectoral and institutional constraints for Chinese software entrepreneurs.

Chapter 9 then presents the results of an inductive study on the development of innovative capabilities that fight off the constraints identified in Chapter 8. The antecedents identified in previous conceptual and empirical research guide the search for innovative capabilities. The focus was on processes, activities and structural features in all parts of the innovation process. More precisely, a set of antecedents for successful innovation is singled out per firm, which was then aggregated to the sector level (see Chapter 9). These antecedents refer to resources and activities that give firms potential competitive advantages for developing and commercializing new product and services. Whereas antecedents refer to resources and activities, capabilities refer to abilities to use those resources and activities. Subsequently, similar processes and antecedents across multiple cases are analysed to identify innovative capabilities. The analysis and the results are presented in Chapter 9.

Chapter 6 – Findings 1

Skill development and education, the financial system and the role of the state in Hangzhou

6.1 Introduction

The chapter presents a case study of Hangzhou that sets the institutional frame in which software entrepreneurs pursue innovative activities. In Chapter 2 I argued that the transformation of institutions in China resulted in the mobilization of resources for IT industries' development: human – and private capital, foreign investment, entrepreneurship and knowledge sharing. Chapter 3 provided an analytical framework for studying the institutions that produce and govern such critical resources. This chapter will identify systematic features of Hangzhou's local institutional environment. The chapter analyzes the provision and distribution of critical resources for software development in Hangzhou: the role of the state, skill development and formal education, and the financial system.

The findings presented here are based on a variety of unique sources. First of all, historical sources and publicly available statistics. Second, extensive interviews with 45 entrepreneurs that provide unique information on skill development and private capital accumulation (sections 6.5.2 and 6.6). Third, I got access to a unique database with first jobs of university graduates of Zhejiang University that provides information about the type and location of their first job (section 6.5.5). Fourth, informal discussions and interviews with students from Zhejiang University across a variety of majors (humanities and science) in the 2006-2008 period provide anecdotal data and valuable insights into the local labour market and job hunting practices of fresh graduates (sections 6.5.3 and 6.5.5). Before discussing the key institutions of Hangzhou's local business environment, I will summarize and extend the main claims about institutions in Chapter 3.

6.2 Resources and institutions: overview of the literature

As state socialist institutions no longer allocate and distribute resources in the economy following a central plan, new economic institutions have to take over that function. The dismantling of state socialist institutions and the development of new institutions causes opportunities and restrictions. The reforms since 1978 have resulted in local diversity of institutional regimes in China (Krug and Hendrischke, 2008; Goodman, 1997; Wong, 2002).

The local production system approach of Crouch and colleagues (2001, 2004) provides an appropriate framework for studying local economic development and institutional regimes as they explicitly studied SMEs in European economies at a sectoral level. Studies like Le Gales and Voelzkow (2001) and Crouch, Le Gales, Trigilia and Voelzkow (2004) provide a basic framework that includes both aspects of institutional regimes. It is useful to distinguish two functions of these new institutions (cf. Coriat and Weinstein, 2002; Crouch et al, 2004; Whitley, 2007): the provision or allocation and distribution of critical resources and the constraints posed on opportunism by key economic agents. Their work suggests that for high-tech sectors in Europe access to research and university facilities, availability of specialized suppliers of goods and services and quality of the local context (physical and social infrastructure) are crucial resources (Trigilia, 2004).

In Chapters 2 and 3 we argued that the critical resources for successful innovation of private software entrepreneurs (SMEs) are capital, labour and knowledge. A set of relevant studies supports this claim. The comparative business system approach has argued how institutions governing capital, labour, product markets, and the public science system crucially affect the development of innovative capabilities (e.g. Whitley, 2002; Casper and Whitley, 2004; Whitley, 2003). More specifically, Whitley (2002) has discussed how the strength of business associations and involvement with public training systems, the organization of the financial system and the public science system crucially affect the development of innovative capabilities. A similar reasoning can be found in the work by Lazonick (e.g. 2007) on the social conditions of innovative enterprise. Lazonick argued with historical examples from Europe and US (Lazonick, 2007) and contemporary examples from China (Lu and Lazonick, 2001) that innovative enterprise depends on organizing, strategizing and financing, which are crucially affected by the institutions that govern capital, labour and knowledge.

More specifically, the innovation system approach has emphasized the central role of knowledge, a point found in the evolutionary literature and work on knowledge-based economies (Edquist, 1997). Consequently, the institutions that govern access to and distribution of knowledge resources are crucial for understanding innovation. Tylecote and Visintin (2008) recently put more emphasis on the role of finance and corporate governance in explaining technological advantages of nations, which included China. Based on these studies, we can usefully distinguish the institutions that govern capital, labour (e.g. Lazonick, 2007; Whitley, 1999; Crouch et al, 2004) and knowledge (e.g. Malerba, 2007; Edquist, 1997; Crouch et al, 2004) as the key institutions for understanding innovative capability development in the software sectors in China: role of the state, skill development and formal education system, and the financial system (role of private and foreign capital). The subsequent sections will discuss each of these institutions in more detail.

6.3 Some remarks on path dependency: role of the state[16]

Institutional regimes in China did not change only exogenously, but also endogenously and carry a certain extent of historical continuity (Krug and Hendrischke, 2007; Tsai, 2007). The broad features and mechanism of institutional regimes are unlikely to change rapidly. This section shows that the role of the state in Zhejiang province is significantly influenced by dominant institutional logics that stem from: the Southern Song period (1138-1276), Treaty of Nanjing (1842) and the Central planning era.

6.3.1 Southern Song (1138-1276)

Zhejiang province is diverse with the North-East flat, developed, industry-oriented, home to China's earliest civilization and connected with the North via the canals and the South-West mostly mountainous and undeveloped[17]. The countryside was called the 'land of fish and rice' with towns with handicraft production and many small markets. Hangzhou – the capital of Zhejiang province - was established during the Qin (222 BC) and emerged as a commercial centre with the construction of the Grand Canal (610 AD) that connected Hangzhou to Beijing. During the Southern Song dynasty (1138-1276 AD), Hangzhou was the capital of China. The shipbuilding industry emerged and led to the development of overseas commercial trade. Ningbo, Wenzhou and Hangzhou were exporting agricultural and industrial products such as silk and ceramics to neighbouring countries. During the Qing and Ming dynasties farmers started to specialize in commerce and handicraft industries. Especially paper making and printing and commerce flourished. Moreover Zhejiang had already many large-sized factories in the early Qing period. At the time Hangzhou was the largest and most commercial city in China. The developed part of the province was home to many educational institutions and had a fair deal of intellectuals promoting commerce and capitalism, such as Yongjia School's Ye Shi. Moreover, since the development of education in the Song dynasty, Zhejiang became the main supplier of bureaucrats during the Ming and Qing dynasties. Hangzhou was the centre of intellectual pursuit and education, next to a centre of commerce and overseas trade and remained so for hundreds of years.

6.3.2 Treaty of Nanjing (1842)

The expansion of capitalism into China started with the First Opium War (1840). The Treaty of Nanjing (1842) signed by the British ceded Hong Kong to Great Britain and

[16] This overview is based on: Zheng, 2007; Forster, 1997; Wei and Ye, 2004; Forster and Yao, 1999; Wei and Li, 2002; Wei, 2005; Forster, 1990; Wei, Leung, Li and Pan, 2008; Hartford, 2003.

[17] There is no strong provincial identity because of the mountains, backward communications and particularistic loyalties (Forster, 1997).

forced the opening of four ports, among which Zhejiang's Ningbo and Wenzhou. Though historically unfair[18], it caused an invasion of Western capitalism in China and with it modern industries, capital and knowledge were introduced to mainly Ningbo, Wenzhou and Hangzhou. A class of entrepreneurs came into being that would lead to the emergence of modern industry in Zhejiang. For instance, the so-called 'Ningbo bang', or Ningbo business people, would later play a significant role in the emergence of Shanghai and Hong Kong. Zheng (2007) reports that between 1887 and 1913 the Zhejiang businessmen established 32 modern enterprises in Zhejiang and 45 in other provinces. In 1921 already 128 enterprises and various private financial institutions were established in the major cities of Zhejiang.

Zhejiang became a bridge between on the one hand Shanghai and the wealthy South but on the other hand, between China and Europe (mostly due to the Wenzhou migrants). Many Zhejiang locals immigrated to European countries to explore business opportunities. Such emigration would prove to be important for Zhejiang economic development because these businessmen would often return to China with accumulated capital and open businesses, for instance in Wenzhou. Zhejiang became at the same time integrated in global entrepreneur networks and developed a strong and independent local business elite. The late 19th century was an intense period for the Imperial state due to the external invasions but also as a result of internal struggles. There was a constant conflict between the imperial state and the local business elite. The state wanted to incorporate the elite's management skills into the empire, whereas the elite wanted to gain greater autonomy and authority. The increasing power of the merchant elite became a 'force from below' to consider in the coming decades. However, economic development was put to a halt during the next few decades.

6.3.3 Central planning era (1949-1978)

Hangzhou was a nationalist (GMD) stronghold in the early 20th century, being the capital of the province where Jiang Jieshi was born. After the Anti-Japanese War (1938-1945) and the succeeding civil war during which the province and Hangzhou were destroyed[19], the communist party had a difficult time to establish itself. In 1949, the Chinese Communist Party (CCP) took over the 'parasitic consumer city', as Hangzhou was called. The CCP first needed to build a strong political structure that would obey central development directions. Their main strategy was to appoint

[18] The Treaty of Tianjin (1858) legalized opium trade, allowed free traveling for foreigners, and introduced Christianity to China. The Treaty of Beijing (1860) marked the fall of Beijing and the end of the opposition of the Manchus. Land division and concessions followed and every foreign power took the opportunity to take pieces of land.

[19] The area around Hangzhou was important in the Anti-Japanese War. Shouxiang, a town near Hangzhou, was an important army base for Japanese troops and the location of the surrendering ceremony of the Japanese troops stationed in Zhejiang province in 1945 (Siegerist, 2007).

outsiders to cadre positions instead of native Zhejiang people. These outsiders were selected for their loyalty to the central leadership despite their low education. They met a lot of opposition because they trained young locals to become compliant cadres. For the next years Hangzhou did not profit from the infrastructure policies, neither was it included in the food policy because it was a risky flooding region. The role of the central government in economic development was limited. Hangzhou was mostly known for sophisticated life styles, the famous Longjin green tea, silk and light industrial sectors and caused the leaders to see it is a scenic relaxation city.

From the beginning there was tension between central government, provincial economic policy and local autonomy. The first measure at the provincial level was to change the ownership structure of the industries. Nevertheless, the private sector continued to play an important role until the mid-1950s. Moreover there was considerable resistance from individual households. Even when local governments used coercive political measures to implement central policies, they were generally ineffective. It is worth noticing that one compromise found which could reconcile private rejections with collective ownership was to establish a household responsibility system in Yongjia county (an institution that would re-emerge in the early 1980s, Zheng, 2007). Yet this initiative was heavily criticized by Mao who since 1955 promulgated the collectivization movement of agriculture.

The Great Leap Forward (1957-59) drew the attention of the central government to Hangzhou and led to the purge of many local officials that would allow or even propose the household responsibility system[20]. Soviet style policy stressing heavy industries, national defence and 'class struggle' was transforming Hangzhou. When it became obvious that heavy industry development was hindered by lack of raw material and local energy supply, the leadership responded by limiting the number of large state-owned enterprises (SOEs) but tolerating collectively owned enterprises (COEs) in the light industrial sectors. Furthermore, the socialization of industry and commerce targeted the capitalist class. The Great Leap Forward caused a migration wave with many Ningbo, Wenzhou and Shaoxing business people from the financial and industrial classes migrating to Taiwan, Hong Kong, further into South-East Asia and even Europe and the United States.

The Cultural Revolution (1966-1978) had the following consequences for Zhejiang. First, the silencing of the intellectual class. Second, the party leadership redesigned its defence strategy. As Zhejiang was considered the First Front for invasions from the Pacific, no further investment was allocated to Zhejiang. Third, chaos and disunity went hand in hand, especially in economic policies. For instance,

[20] For instance, Zheng (2007) reports on Chen Xinyu, a local state official in Xinchang county that defended the Household responsibility system and how it would promote agricultural growth. Of course, Chen and his ideas got heavily attacked by the centre.

there was strong opposition towards the agricultural policy. Fourthly, the self-reliance policy reduced maritime trade to the detriment of coastal cities, such as Wenzhou, Ningbo and Hangzhou.

One consequence of the Great Leap Forward and the Cultural Revolution in Hangzhou, as in the rest of China, was the emergence of an informal sector. Then, for example, it is worth emphasising that some authors such as David Wank claim that only at this time the word *guanxi* (network) made its appearance. Here *guanxi* refers to a local business community that, appalled by formal policy, organized the business relations outside the official business system (Wank, 1999; Wei and Ye, 2004)[21].
In the early 1970s a new pragmatic leadership realized the destructive nature of the Cultural Revolution and focused on developing new industries and the return of urban youth. However, the urban youth returned from the country side during the late 1970s that often meant unemployment. Controlling migration and urbanization became crucial; especially considering the pressure on food, jobs and urban services. The promotion of rural industries and the performance of the collective rural sector started to stimulate economic development in the late 1970s.

To sum up, the Great Leap Forward and Cultural Revolution left Hangzhou's economy with a comparative disadvantage: shifting central investment decisions, sectoral and regional policies detrimental to Hangzhou's natural comparative advantages such as an agricultural policy favouring grain production instead of cash crops; heavy industry focus; and reduction in maritime trade. However, local autonomy and the informal business sector ensured the survival of small scale enterprises, low bureaucratic intervention and a strong awareness of commodities. All this together paved the way for market-oriented reforms and the development of non-state enterprises.

6.3.4 Reform period: dismantling the socialist economy

The reforms focused on decentralization and marketization as well as opening up to the outside world. However, Zhejiang was not leading the reform movement in China. As was shown by Forster (1990), factionalism in Zhejiang during the Cultural Revolution had divided the provincial party cadres and resulted in power struggles that would not end with Mao's death. These political divisions caused the government to mostly fail in the implementation of committed developmental strategies. Such as the resource policy debates - basic heavy industries versus light industries - or the opening up to international trade. As a result the province was rather slow in liberalizing international trade.

[21] Economic historians on the other hand claim that *guanxi* already emerged in the 19th century (e.g. David Faure, 2006).

Fiscal federalism[22] (Qian, 2000; Qian and Weingast, 1997) in 1980 changed the tax structure and allocated budgets to the local level. This decentralization of taxation led to local autonomy and diversity of local business systems. Local provincial officials now had a strong incentive to expand the amount of investment. Hangzhou profited immensely from fiscal decentralization. The collusion of local government and business community interests – increasing revenues - more or less resolved previous issues. One consequence was the emergence of the private sector. The COEs were reformed to TVEs behind which often enough private firms were hidden. The private sector was thus slowly being restored and decision making power was decentralized to the enterprise level. The local economy saw a spur in development and growth. Fast local economic development had also dramatically increased the people's living standards, bank savings and cash deposits. This further increased the demands for commodities, raw materials and energy in Zhejiang. For that reason, the local government went to great lengths to promote horizontal economic cooperation. Horizontal cooperation was historically important because of Zhejiang's shortage of raw materials and energy. Since 1985, Zhejiang became integrated within the rest of China by providing financial resources and technologies in exchange for raw materials and energy.

International trade did not take off until the mid-1980s when the 7th Five Year Plan had given foreign trade high priority. After the political turmoil of the Tiananmen Square Incident the tides really turned[23]. Many favourable policies for foreign business were put in place, such as tax holidays, free land, preferential access to resources and free access to workers. The end of the 1980s and early 1990s saw the establishment of various development zones attracting and promoting foreign enterprises. With eased restrictions, simplified approval procedures and globalization of the Yangtze Delta and Shanghai, Hangzhou and Zhejiang in general became magnets for FDI.

As part of the economic policy aiming at the integration of Hangzhou in China, the government first established a variety of development zones, such as the Hangzhou and Xiaoshan economic and technological development zones (1993). Hangzhou is currently home to the High Technology Development Zone, national software industrialization base, the IC design industrialization base, the national electronic-information industry base and the national animation industry base. Second, firms were increasingly being assessed by economic performance instead of political loyalty and reaching quotas. Thirdly and crucial for the IT industry I am concerned with here the national policy with respect to information and communication is reformed.

[22] See Chapter 3 for an extensive treatment of 'fiscal federalism' in the Chinese context

[23] Especially after the visit of leading reformer Zhao Ziyang, the then General Secretary of the Communist Party of China (1987-1989) who was purged for his support of the Tiananmen students and succeeded by Jiang Zemin.

Changes in communication policy can be seen in the national Golden projects (1993) and was soon followed by a Work Leading Group (1996) and the Number One Project (2000) on a local level. At the national level the push for informatization involved e-government (1999), enterprises online (2000) and households online (2001) campaigns. The local Number One Project was a ten-year plan for developing the Hangzhou high-tech sectors. The focus sectors were software and telecommunications equipment and four firms were chosen to 'lead the development', Eastcom, UTStarcom, West Lake Electronics Group and Great Nature (Hartford, 2003). There were 15 local projects, with limited central coordination, no government commitment to funding beyond those directly related to government functions and the clear expectation that firms would make their own investments. This strategy allowed for competition, non-intervention and variety of ownership forms and eventually led to the development of new sectors such as e-commerce and financial transaction products and services.

Hangzhou developed into a **local business system**[24] with specific features (Krug and Hendrischke, 2008; Wei and Ye, 2004): First, non-intervention management[25], to choose a local economic regime that is characterized by low levels of government involvement and considerable freedom for market exchanges and transactions. Second, presence of institutional mechanisms to promote the development of high-tech sectors locally in the form of development zones. The overall output of IT products in these zones accounts for one-third of Zhejiang province. A closer look at such institutional mechanisms is warranted (section 6.4).

Third, the rapid development of a private sector. Being a relative failure during the Mao years resulted in an advantage during the beginning of reform. The reforms were easier because of the relatively small role of the traditional socialist plan, not too much overregulated industries, and most of all, the restructuring of the few SOEs left the province with relatively few unemployed. The strong commodity economy tradition and the underground 'private' economy during the Mao years caused that in 1984 already the state sector was no longer the biggest and since 1997 private enterprises were the dominant economic actor. Fourth, Hangzhou became attractive for foreign investment. The province was relatively slow in opening up in the 1980s and therefore not really influenced by the Tiananmen Incident. The mid-1990s brought a wave of FDI. Especially global networks of Chinese immigrants – that left China

[24] A local business system is here understood as an distinctive patterns of economic organization *at the local* level with a specific mode of authoritative coordination of economic activities and interconnections between owners, managers, experts, and other employees (cf. Whitley, 1999). The word 'system' implies a relative stability of these features but it has to be noted that in this specific context it refers to 'distinctive patterns' which are not necessarily stable but suggest processes and features after 30 years of reform in Hangzhou.

[25] The Chinese government uses a specific term for a non-intervening government: wuwei erzhi

during earlier periods, especially from Ningbo, Wenzhou and Shaoxing – played an increasingly significant role by transferring knowledge and other resources to China.

The role of the local government in Hangzhou has been at arm's length. However, the only significant exception is the establishment of technology zones and parks which function as institutional mechanisms to facilitate the development of high-tech industries for instance via tax reductions and provision of telecommunications infrastructure. The remainder of the chapter focuses on the role of the state in high-tech development zones (6.4), the skill development and formal education system (6.5), the private capital (6.6) and foreign investment markets (6.7).

6.4 Research institutes, Technology Zones and Parks

In the diffusion and commercialization of public knowledge, research institutes, technology zones and science parks stand out as institutional mechanisms to promote IT industries' development. By the end of 2006, Hangzhou has 260 R&D centres, including 92 provincial-level R & D centres, 168 municipal-level R&D centres. There were 65 enterprises authorized as state-level high-tech enterprises, 895 provincial-level high-tech enterprises and 139 municipal-level high-tech enterprises (Hangzhou Statistics Online, 2008). In 2006, a total of 6.164 billion RMB had been invested into R&D projects in the enterprises, up by 21.8 percent over the previous year. Furthermore, the city had 30 enterprise incubation parks with more than 1,000 square meters, covering a combined space of more than 665,000 square meters. A total of 10,719 patent applications were submitted and 5,742 patents were authorized, up by 13 percent and 41.0 percent over the previous year respectively. Many of those research institutes are part of a technology zone or science park.

Zones and parks do not refer to geographic areas but to administrative units. Usually the zones have many locations spread across the city. Furthermore, such zones can include several other administrative levels and incorporate other zones. Hangzhou has a special position by having several large state level development zones. Three stand out. The *Hangzhou Economic & Technological Development Zone* (HETDZ) is established in 1993. It focuses on four industries, such as electronics and information industry, biology and medicine industry, machinery and manufacturing industry as well as foods and beverage industry. Recently, the Xiasha High Education Park, the largest scale in Zhejiang province, and the first experimental unit in China, Hangzhou Export Processing Zone, were constructed. The *Xiaoshan Economic and Technological Development Zone* (XETDZ) was established in 1993. Within the Zone are the Japan Sizuoka Industry Park, Taiwan Mechanical Industry Park, Province-level High-Tech Industry Park and Chinese Woman's Dress Industry Park. Pillar industries

had currently been formed in textile and clothing, machinery and hardware, architecture and building materials, electronics and chemical engineering (**Table 6.1**).

Table 6.1 – Features of key development zones in Hangzhou (2006)

	Total	HETDZ	HHNTIDZ	XETDZ
Area of Development(sq.km)	76.39	34	12.64	22.2
Investments in Infrastructure(100 million RMB)	144.55	47.76	51.67	36.45
Number of Enterprises Approved(unit)	4828	1572	2500	697
Foreign Investments Enterprises(unit)	1361	426	475	410
Number of Enterprises in Production or Operation(unit)	2843	1176	950	697
Sales Revenue(100 million RMB)	2,615.44	1,201.44	1047	363.2
Gross Industrial Output Value(100 million RMB)	2,262.7	1,113.4	804.9	344.4
Fulfilled Profits and Tax(100 million RMB)	186.67	70.59	80.6	35.2
Financial Revenue(100 million RMB)	92.73	32.57	42.8	16.27

Source: Hangzhou Statistics Online, 2008

Lastly, the *Hangzhou High & New Technology Industry Development Zone* (HHNTIDZ) was established in 1990. It covers three main areas: River North, River South (Binjiang) and Xiasha. The zone focuses on telecommunication and software industries, integrated circuit and digital television industry and the promotion of two new industries: animation and network game industries. It administers another eight state-level bases and state-level career & service centres, such as the Software Industry Base, the Returned-student Careering Park, the Telecommunication Industry Base, the National Export Software Creation Base and the Experimental Base of Software Engineering Exports to Europe & America. **Exhibit 6.1** provides an example of the East Software Park, one of the Parks that is part of the HHNTIDZ.

Exhibit 6.1 – The East Software Park

The East Software Park is situated in the center of Hangzhou, inside the national hi-tech industrial development zone. They have about 200 members, among which Alibaba, AsiaINFO, WebEx and Huawei. The main purpose of this software park is to provide office space with telecom infrastructure. Furthermore, the ESP provides services and management assistance. The main issues they help with are related to employee recruitment and management skills. Furthermore, they provide their customers with up-to-date information regarding new rules and regulations from central or local government agencies. ESP cooperates with governments and firms.

Four features of the HHNTIDZ are noteworthy. First of all, firms in the zone enjoy special preferential policies. Tariffs on equipments, 2 years tax exemption and 3 years half deduction of taxation provide incentives for re-investment, foreign investment, technology transfer and investments in software sectors. HHNTIDZ is an administrative district and thus performs all the functions of a government and is endowed by Hangzhou Municipal Party Committee and Hangzhou Municipal Government with a specific policy of administrative affairs handled within the district. The revenues can be used by the district at will. Second, HHNTIDZ is close to the Hangzhou Xiaoshan International Airport and borders Shanghai-Hangzhou-Ningbo Expressway. Furthermore, the municipal administration centre will move near the HHNTIDZ districts. Third, HHNTIDZ has established a long-term cooperative relationship with higher educational institutions such as Zhejiang University and scientific research institutes such as Chinese Academy of Sciences. Fourth, the zones accommodate nearly 5,000 enterprises of which 445 are foreign-funded enterprises with a total investment of US$ 2.7 billion.

Next to the state-level development zones, there are also several university Science Parks. The most dominant is the Zhejiang University Science Park (ZUNSP). The ZUNSP is one of the 15 national university science parks approved by Ministry of Science and Technology and Ministry of Education. The ZUNSP is founded by the provincial and municipal government together with Zhejiang University. The Science Park has 3 subsidiaries: Nanchang, Ningbo and Hangzhou Binjiang District. The focus is on new technologies in IT, life science and modern agriculture, new materials and nano-materials industries.

In short, the state plays an active role in technology zones and parks. In order to expand the software sectors, more and better qualified academics and skilled workers were needed. While the latter can be trained in-house, the former have to pass the state controlled university system. Basically, the software sectors asked for new work profiles; how would these fit with the formal education that workers get? The software sectors need academic and non-academic training.

6.5 Education and training (critical human and knowledge resources)

6.5.1 Formal education

The education system follows the national model: regular education, higher education, adult, civilian and special education[26]. In 2006 there were 36 general colleges and universities with 349,976 students and 80,069 graduates. The gross enrolment rate of colleges and universities was 48.55% per year, which is much higher than the national

[26] The following statistics are derived from the Hangzhou Statistics Online website.

average. The average student/teacher ratio in Hangzhou is similar to the national average with about 16 students for each full time teacher. However, the top university in Hangzhou, Zhejiang University scores much better, with only 7 students for each teacher. Of the 36 colleges and universities, 7 stand out in terms of numbers of students and prestige (**Table 6.2**).

Table 6.2 – Universities in Hangzhou and key indicators (2006)

	students	graduates	total teachers	full time teachers	student/ teacher
Zhejiang University	23,668	6,115	8,504	3,531	7
Zhejiang University of Technology	20,839	4,282	2,363	1,383	15
Hangzhou Electronics University	15,560	4,288	1,348	851	18
Zhejiang Gongshang University	13,479	2,752	1,541	860	16
Hangzhou Applied Eng. College	12,597	1,990	1,110	675	19
Zhejiang SciTech University	11,499	2,122	1,179	742	15
Zhejiang University City College	11,495	2,529	802	595	19
Total	*349,976*	*80,069*	*36,929*	*21,375*	*16*

Source: Hangzhou Statistics Online, 2008

Zhejiang University plays a significant role in Hangzhou, not only in academics and teaching but also in business. Many of the enterprises in Hangzhou are related to Zhejiang University, either via the strong alumni networks or via collaborations of various kinds. All the enterprises in my sample are connected to Zheda in one way or the other. Zhejiang University has its origins in the Qiushi Academy (1897) one of the oldest institutions of higher learning in China. However, the current form and structure of Zhejiang University is relatively new. In 1998, with the approval of the State Council, the new Zhejiang University was established as a combination of four major universities: Zhejiang University, Hangzhou University, Zhejiang Agricultural University and Zhejiang Medical University.

Zhejiang University is a comprehensive university, which covers all the academic fields: philosophy, economics, law, education, literature, science, history, engineering, agriculture, medicine and management. However, it is widely known as a technical university and considered one of the three best technical universities in China. It is a major research university comprised of 24 colleges with 112 fields of undergraduate study, 317 fields for master degree study and 14 fields for professional master degree.

The university always had a high status and became known as the Cambridge of the East. Although that title might be a bit premature, it is a fact that Zheda is among the top universities in China. It is ranked no two in China in terms of scientific papers published. Furthermore, the business school has international AMBA accreditation and was ranked number 3 after Tsinghua University and Beijing University by the China Academy of Management.

Exhibit 6.2 introduces the three relevant colleges for IT and high-tech related studies: the recently established Zhejiang Institute for Innovation, International; the college of computer science (including the national level software engineering college) and College of Information Science & Engineering.

Exhibit 6.2 – Computer Science, Information Science & Engineering and Institute for Innovation

The first major (Electronic Computer) in computer science was established in 1973; the first major in software in 1973 by the Department of Applied Mathematics. Then in 1978 the Computer Science Department (education and research), covering both software and computer technology, was established. Software Technology College is affiliated to the Computer Science College but is since 2001 a National Model College of Software Technology; receiving extra finances and being under state supervision (Ministry of Education and National Development Planning Committee).

The College of Information Science & Engineering was established in 1999. The College has three departments: the Dept. of Optical Engineering, Dept. of Information and Electronics Engineering, Dept. of Control Science and Engineering. The College has strong capabilities in the fields of control theory and industrial processing control, optical engineering and electronic science and technologies. The college has four National research bases and one provincial key laboratory.

Then in 2007, Zhu Min (see Exhibit 6.3) founded the Zhejiang Institute for Innovation, International (ZII). ZII's goal is to "build a new chain of cooperation in international R&D innovation, ecological innovation and economic development" (ZII website). They have a relationship with Stanford University and many American Silicon Valley enterprises. ZII is attached to an independently operated nonprofit organization within Zhejiang University. Noteworthy is that The Global Science and Technology Bank and the Venture Capital Fund are integrated in the business model of ZII.

6.5.2 Job-specific training

IT capabilities cannot only be developed in the formal education system but also needs semi-formal training, i.e. training is complementary to the formal education system. In-house and on-the-job training arrangements have become important strategies for developing technical and management skills (Xiao and Tsang, 1999). The Decision on the Reform and Development of Adult Education (1987) stipulated that job-related training should get the highest priority as a tool to develop job-specific skills that cannot be provided by the formal educational system. The decision has been implemented in various ways: integrated on-the-job training, job-related technical drills, short-cycle training classes, thematic lectures and supervised self-study (Xie, 1994). However, detailed information on the development of job-specific skills is absent. Moreover, only a handful of studies looked into the topic of on the job training in Chinese organizations. Most of those studies focus on foreign-Chinese joint ventures. In order to provide insights into on the job training and HRM practices in new private enterprises, I choose to employ data from my sample of entrepreneurs. This data provides unique insights into the HRM systems of private software enterprises in Hangzhou's local business environment. **Table 6.3** summarizes the main features of the firms in our sample.

Table 6.3 – Features of HRM systems in my sample of software firms

Feature HRM system	% of firms have
On the job training	40%
Employees with bachelor or higher	63%
Use of project teams	70%
Employee involvement in decision making	34%
Requirements new employees:	
Skill	47%
Team player attitude	44%
Learning ability	33%
Compensation schemes:	
Use of bonus system	81%
Use of performance-based pay	46%

Source: author's data on 45 software entrepreneurs in Hangzhou (2006-2008)

First of all, the interviews suggest that private software entrepreneurs have a strong 'capability-building' and 'learning' perspective on human resource management. When recruiting new employees the three most important requirements are skills, team player attitude and learning ability. Moreover, over 60% of new recruits on average have a bachelor degree or higher. The compensation system also fits a performance-driven HRM system, 81% of the enterprises uses a bonus system and 46% use actual a performance-based pay system. Second, over 70% of the enterprises use cross-

functional project teams. Project teams here refer to teams with both R&D and marketing personnel that is set up for specific projects and only for the duration of the project. This suggests that there are many (informal) opportunities for learning across functions and on-the-job.

Third, what is striking is the relatively high level of employee involvement in enterprise decision making, about 34%. To some extent this is related to the smallness of these enterprises but more generally it indicates that employees are involved in the broader enterprise decisions. On the one hand, this signals trust from higher management in the employees' skills and ideas, on the other hand, it promotes learning and interaction among different levels in the firm's hierarchy.

Fourth, 40% of the firms use on-the-job training. Several features stand out:

(1) The use of training is generally *not standardized* and works on a case-by-case basis or for specific projects. For instance, Firm 22, an online search engine software firm, does not provide formal training but has a mentor system that allows peer training. Similarly, Firm 6, an ERP software firm, has few regular training projects and training programs, the great majority is of temporary nature. For instance, after a new software introduction, they might invite experts to provide training, as well as collective studying of employees. The company is not able to arrange a lot of specialized external training, but they can have some business exercises, via external personnel studying new knowledge and technology.
(2) Only in a few cases training has become a part of the *enterprise's system*. For instance, the development of new software in Firm 52, an enterprise network communication software firm, involved not only comparing competitors' products but also investment in specialized training. The entrepreneur asked Microsoft to give technical training to several persons in the R&D department. Sometimes, firms provide entry-training. Firm 39, a middleware firm, provides one-week training for new employees.
(3) Sometimes firms will have *external training*, by a consulting agency. For instance Firm 13, a telecom service provider, provides employees with the opportunity of getting skill-orientation training and technology training. Another example is Firm 54, a community management software firm. Over 85% of the employees participate in training, every time about 170 employees participate. Most important training is in the areas of technology, quality, and interpersonal communication.
(4) In general, entrepreneurs will ask *personal friends*, such as classmates and teachers, to provide training in the company, to save money on formal training agencies. For instance, Firm 38, a financial enterprise software firm, can't provide

> many outside training opportunities for the employees because of financial limitations. However, the management will use their own network to invite friends to give lectures and training to employees. Furthermore, the firm organizes seminars to discuss and learn from each other.

The interviews suggest that training refers to learning practical skills as opposed to academic skills. Trainings are focussed on communication skills, application of technical knowledge to business cases and developing skills for problem solving within the area of expertise. Generally, training is often seen as a 'reward' and intended to motivate employees (cf. Ng and Siu, 2004), while committing them to develop certain – though limited in use – skills for the firm. Lack of financial resources and knowledge about training at the managerial level are the key constraint for training in these small firms. Technical training and development of critical skills cannot be done (yet) in these small firms. More generally, training on the job in China is still in the early stages and oftentimes falls short of the expectations (Ng and Siu, 2004). The need for training is recognized in the firms in my sample but the managerial skills and financial resources do not yet facilitate efficient and effective training on the job.

6.5.3 Students and alumni networks: The '88' BBS

As mentioned before, Zhejiang University has a strong presence in Hangzhou. One way is the involvement of many enterprises with the university. Another way is via the university students and alumni networks. A good illustration – and one of the most important institutional mechanisms – is the '88' BBS of Zhejiang University. Students from the Computer Science College set up the BBS in 1998. It has 9 or 10 main topics each with several sub-boards. Every board has one board master that is responsible for the content and control of the board. He/she also gives rank/status to posted items. There are about 60 board masters in total. The board masters cooperate and discuss with each other. The BBS is called '88' because the last two numbers of the IP address are 88. It is like a club or community and it even has special T-shirts. During daytime 4,000-7,000 students/alumni/professors are online using the BBS at the same time. It has a Telnet interface. Every student can register for the BBS and keep the account forever, also after graduation. The BBS is accessible outside the university network. Students manage the BBS and the university provides the necessary infrastructure. The university controls/monitors the content of the BBS.

The topics are related to many aspects of a student's life: course material, dating, job searching and entrepreneurship. Companies, usually big companies, use the BBS to advertise and to post vacancies. Normally these companies use 'ambassadors', i.e. students that are hired or alumni that still have access to the BBS to put messages on it.

One of our interviewees masters the entrepreneurship topic. He and other entrepreneurs use it to communicate to students but also to test new products/technologies. For instance, the latest new software was put on the BBS with the request for students to test it and help getting the bugs out. Furthermore, the entrepreneurship section contains information, about rules and regulation of setting up a company. The entrepreneurs share this information with students and potential entrepreneurs. Overall, this strong network connects the university, entrepreneurs and students in sharing knowledge and information.

6.5.4 Volume of IT capabilities: Employment and wages

What, then, is the employment situation in Hangzhou anno 2008? First of all, we see a shift in employment towards the tertiary industries of which the IT sector is a part. The potential talent pool in Hangzhou is significant with over 250,000 undergraduate students, 20,000 graduate students and a high level of IT literacy (World Bank, 2006). In total there are 5.1 million working individuals in Hangzhou city. Nevertheless the amount of people working in IT related industries is relatively small (2% of total employees; 97,200 people). Most people work in the secondary industries, although the share of tertiary industries is rising (**Table 6.4**).

Table 6.4: Employment in Hangzhou's sectors

	2006	2005	2004	2003	2002	2001
Primary sectors	17.0%	19.1%	19.3%	22.7%	24.4%	27.5%
Secondary sectors	45.7%	46.2%	48.1%	40.5%	38.5%	34.6%
Tertiary sectors	37.3%	34.7%	32.7%	36.8%	37.1%	37.9%

Source: Hangzhou Statistics Online, 2008

Second, employment is better compensated; both in comparison to the national average and over time. When we look at wage development in Hangzhou and compare it to the national average, we can conclude that the wages in Hangzhou are structurally higher (**Table 6.5**, next page). Since the reforms started, the wages increased significantly from only 597 RMB annually to 31,440 RMB. Until the 1990s, the average wages in Hangzhou and the national average where similar (around 2,300 RMB in 1990). However, especially after 2000, the differences increase significantly. It is interesting to compare across ownership forms. It appears that wages in SOEs are significantly higher than in collectives or other forms of ownership (private business). This can be explained by the fact that private enterprises are dominant and that SOEs need to offer higher salaries to attract employees. In Hangzhou, the government or state-owned enterprises are no longer the preferred job locations.

Table 6.5: Employee compensation in Hangzhou compared to China's average

	Hangzhou average wages in RMB				China average wages in RMB			
	Average	SOEs	Collectives	Other	Average	SOEs	Collectives	Other
1978	597	634	509	-	615	644	506	-
1980	777	832	660	-	762	803	623	-
1985	1,266	1,302	1,188	1,287	1,148	1,213	967	1,436
1990	2,382	2,504	2,078	2,582	2,140	2,284	1,681	2,987
1995	7,156	7,546	5,604	8,266	5,500	5,625	3,931	7,463
2000	13,715	15,010	9,660	12,666	9,371	9,552	6,262	10,984
2005	30,580	39,748	22,794	24,003	18,364	19,313	11,283	18,244
2006	32,440	43,978	21,570	26,396	21,001	22,112	13,014	20,755

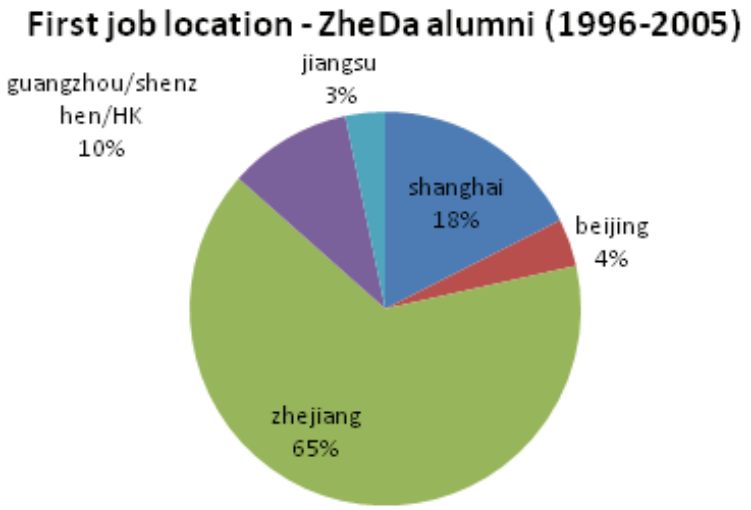
Source: Hangzhou Statistics Online, 2008.

6.5.5 Local labour market and graduate career patterns.

What is the actual job market situation in Hangzhou? Information on career development in China is just as limited as most of the information on labour and employment. However, to get an insight in the labour market for graduated students in IT related fields of study, I use new empirical data from a unique data set with first job information of over 7000 graduates from Zhejiang University over a period of 10 years (1996-2005). Even though there is considerable missing data, the suggested patterns provide valuable insights. There is no information about how many people did not find a job; they are counted as missing information. Nevertheless, the data provides insights into the careers of a new generation of young IT professionals.

Where did the graduates get their first job? The data (excluding those who went abroad) suggests that most graduates stay nearby: 65% within the province, 18% in Shanghai and a small 3% starts to work in the nearby Jiangsu province. Only 4% will start to work in Beijing, which is still considered the main place to be for IT industries. The other IT centre of China, the Guangdong area, attracts about 10% of graduates. Of the people that stay in Zhejiang province, more than 50% work in Hangzhou. Informal interviews with about 30-40 Zhejiang University students that were graduating suggests that there are two reasons for this geographical concentration. First of all, the cultural differences between north and south of China are considered to be significant. Especially if the student is originally from the south, it is unlikely that he or she will move to Beijing for work and living. Second, the competition in Beijing from Beijing University and Tsinghua University students is fierce. Zhejiang University is a good university, but still considered to be inferior to Beida or Tsinghua. In sum, there is a low level of geographical job mobility (**Figure 6.1**, next page).

Figure 6.1: First job location



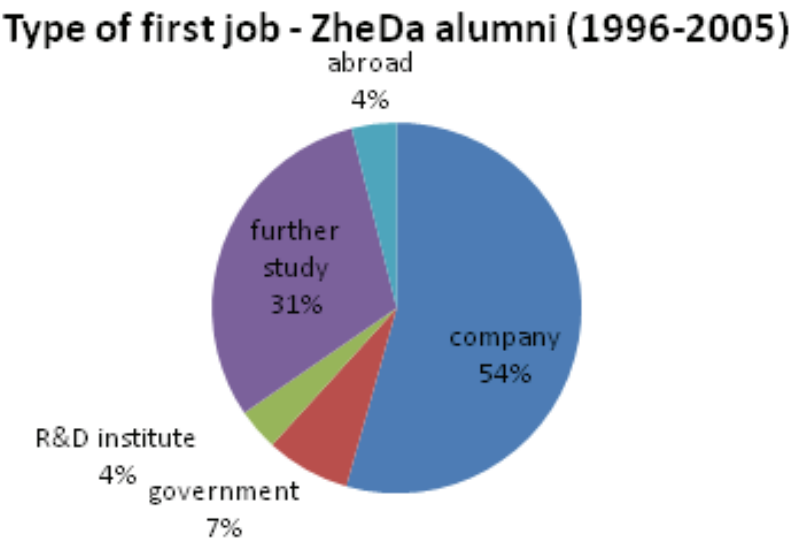
Source: Zhejiang University Alumni Database, (1996-2005)

What kind of job did the graduates have as a first job? First of all, over the 1996-2005 period on average about 4% of the graduates went abroad. There is no structural information as to where these students end up, but informal interviews suggest certain preferences: USA. Unsurprisingly the majority of students found a job in a company (54%). A large proportion continued studying, 31% of the students (**Figure 6.2**, next page). It is no surprise that the number of PhD students is large. Doing a PhD is often seen as a last resort, if no other job can be found. The accumulated academic skills during a PhD project are not often seen as a valuable complement to a BSc or MSc degree. This suggests that the level and quality of PhD studies is not as high as in Western-European of US-American societies. A small proportion of students end up in the government (7%) or in specialized research institutes (4%). In contrast to the low geographical job mobility, the workplace mobility is high. Both anecdotal evidence and data from my interviews suggest average annual labour turnover rates of 20-30%.

How do graduates search for a job? In the absence of survey and statistical data we will use anecdotal evidence on the basis of my frequent interaction with Zhejiang University students in 2006-2008 to provide insights into the local labour market, in particular the 'job hunt' of graduates in the last year of their study. Informal discussion and interviews suggest that graduates has a strong preference for large foreign firms such as P&G, Philips, PWC, Deloitte, GM, Accenture, etc. Typically, each student applies to a large number of vacancies at the same time. This can be as much as 30 to

50 applications per student. Students apply to a wide variety of functions and jobs, regardless of their particular major, interest and motivation. Students generally have three ways to find information about job vacancies: 1) job hunting websites such as Yingjiesheng, 51job and Hiall[27]; 2) campus recruitment talks; 3) Zhejiang University Graduation Website[28]. Personal introductions and family or friends at foreign firms usually do not give students an advantage.

Figure 6.2: Type of first job



Source: Zhejiang University Alumni Database, (1996-2005)

The applications involve online registration and tests at job hunting websites and offline interviews. As the students all graduate at the same time across China, companies have online tests that intend to make a qualitative selection. However, the reality is that those tests – and even the interviews – are similar across companies and years. The students exchange their experiences and even copy/paste screen shots of tests onto the university BBS[29]. Moreover, as these tests are roughly similar, students can gain experience by doing more tests at more companies[30]. So generally, the use of these tests is limited and foreign firms receive large amounts of applications (e.g.

[27] www.yingjiesheng.com; www.hiall.com.cn; www.51job.com.cn
[28] 浙江大学就业指导与服务中心: http://www.career.zju.edu.cn/cs/
[29] There is even a special word for this 'learning from others': 面经 (mianjing)

several ten thousands per firm). Then, whenever a student gets an offer, they will continue to apply. Even though most students get one or no offer[31], some lucky students manage to get 4 or 5 offers and select only at the latest stage the desired offer. In sum, this anecdotal evidence suggests that the job searching process for fresh graduates in foreign firms is relatively inefficient for both the students and the companies. The small number of students that is applying for small private firms, government positions or state-owned enterprises face a very different job hunting process. Across all these sectors, personal introduction and relationship networks are by far the most crucial factor for finding a job. Both the informal interviews with students and the interview data of my sample of firms suggest that the so-called *guanxi*-factor is crucial for finding a job in a small private firm, SOE or government.

Summarizing, human capital development has many opportunities and restrictions for the IT industries: better monetary incentives for IT and academic jobs; social networking within certain sectors; supplementary training organized by companies; high reputation of the universities in Hangzhou. However, scarcity of competences, low geographic mobility and high workplace mobility and the need for specific competences in IT that cannot be provided by the formal education system.

6.6 Private capital accumulation and savings (critical financial resources)

Where does Hangzhou's wealth come from? A closer look at stock listings, private savings, foreign investment and loans suggests that there is considerable private capital. First of all, the number of listed companies in Hangzhou reached 50 in 2006, an increase of 4 compared to 2005. Of these 50 companies, 40 companies are listed on Chinese stock markets and 10 companies are listed on overseas stock markets. Money raised through stock markets reached 3.55 billion RMB in the whole year (Hangzhou Statistics Online, 2008). Firms that make it to the stock market usually are backed by state support (such as the initial IPOs of sina.com for instance on NASDAQ). Moreover, most of the stock-listed companies are state-owned or are indirectly controlled by government agencies. However, as in Western economies, stock markets are not the main sources for investments for most enterprises. In Hangzhou, it is private savings and foreign investments that provided the capital for most enterprises.

Private savings were virtually non-existent at the beginning of the reforms. However, the average savings in Hangzhou in 1990 already amounted to 1,215 RMB, which is a large percentage of the annual income (60% of 1,999 RMB). This is not only twice the national average but also a larger portion of the annual income (cf. China: 41% of

[30] Moreover, students confided to use fake names and accounts to take the same test multiple times in order to learn how to make it most efficiently.

[31] Unemployment under fresh graduates is high

1,510 RMB). Especially the last five years the growth in savings is noteworthy: an average 20% increase in average savings per capita (compared to 16% national). In 2006 a person has on average 38,367 RMB on his savings account, which is more than the equivalent of an average annual income (21,367 RMB) (see **Table 6.6**).

Table 6.6: Savings per capita in Hangzhou compared (RMB)

	China	Hangzhou
1978	22	41
1980	40	79
1985	153	294
1990	623	1,215
1995	2,449	5,734
2000	5,076	12,698
2001	5,780	14,974
2002	6,766	18,607
2003	8,018	24,766
2004	9,197	28,190
2005	10,787	33,207
2006	12,293	38,367

Source: Hangzhou Statistics Online, 2008

Tsai (2002) argued how important private forms of banking are for entrepreneurs in China, thereby denoting the limited use of 'official' bank loans. Looking at the banks in Hangzhou and their loans, I come to the same conclusion. The amount of loans compared to the savings or foreign investment volume is insignificant. For instance, in 2006, total loans amounted to 649 billion RMB, however savings were 16,000 billion RMB and FDI was about 1,060 billion RMB. If we compare the value of loans per capita to FDI and savings, the differences become even more striking. In 1995, loans were still practically non-existent, whereas foreign investment (1,213 RMB) and private savings (5,734 RMB) were already significant. In 2006, the difference is large, with only 502 RMB value of loans per capita, compared to a value of 8,599 RMB of foreign investment and 38,367 RMB of savings per capita. Overall, the role of banks as capital providers is insignificant compared to foreign investment and private capital.

Furthermore, as can be seen from the data of the last 4 years (**Table 6.7**, next page), only a small percentage of the loans flows to the private sector or innovation related projects. Even though the total amount of loans has been increasing significantly over the past 4 years, these loans did not reach the private sector. On average only 2% of the loans went to private firms and this did not increase over the last years. The same holds for innovation funding. It is clear that investments in the upgrading of existing technological systems does not originate in bank loans. Private –

and foreign capital is clearly the main sources of investment for private entrepreneurs in Hangzhou.

Table 6.7: Loans in Hangzhou

in 10,000 RMB	2003	2004	20005	2006
total loans	36,869,000	46,511,600	54,256,100	64,960,300
short term	20,502,000	24,128,300	27,355,700	33,875,900
medium and long term	13,210,600	17,340,200	21,208,100	25,872,100
for foreign invested enterprises	716,000	752,200	920,800	940,900
for private sector	772,900	1,067,700	1,040,400	1,580,300
for innovation	4,400	232,200	302,200	265,300

Source: Hangzhou Statistics Online, 2008

This general pattern is confirmed in my sample of private software entrepreneurs. Most investments come from the entrepreneurs and a select small group of informal private investors. This amounts to – on average – 57% of investments, usually initial, start-up investments. Usually a mix of different sources is used. So, for instance, founder's capital and later an investment firm or government funds investment. The latter is not to be underestimated. On average 21% of investments originates in special government funds, often designated for young, private entrepreneurs in specific high-technology sectors. As to the investment company, usually, after initial success an investment firm will provide additional capital, on average 31% of investments. In a few cases, 7% of investments, stock listing is the way of capital accumulation.

Where is all this capital invested in? The most insightful data on investments in Hangzhou are the figures on investments in fixed assets. The Hangzhou statistical yearbook provides sectoral data for the reform period. First of all, the agricultural sector and other primary industries hardly receive any investments, which is not surprising given the relative unimportance of these sectors for Hangzhou's economic development (see previous section). The secondary – manufacturing – industries and tertiary industries in general share most of the investments until the 1990s. The last decade and a half, the tertiary industries start to receive most of the investments. Most of the investments flow into capital construction and real estate. Nevertheless, a significant amount of investment is put in innovation. Innovation has become a 'budget' item on the local government agenda, which is also clearly resonated in the current official slogan 'innovation to create a harmonious society'.

All in all, it is private savings, not bank loans, that is providing opportunities. Moreover, investments are shifting to the tertiary sector, of which the IT industries are part. Access to banks and low availability of bank loans are the main restrictions.

6.7 Foreign investment (critical financial resources)

Hangzhou has been strong in attracting foreign investment. Hangzhou was rather late in opening up and had low level of foreign investment. Before the early 1990s the amount of equal to less than the national average in terms of percentage foreign investment of GDP, even though the per capita investment was higher than average. It was only after the famous 1992 opening up 'movement' that Hangzhou started to attract large amounts of foreign investment, surpassing the national average largely: foreign investment amounting to 22.9% of Hangzhou's GDP and about five times the national average per capita ratio. Over the whole period Hangzhou's foreign investment growth rate was 8.2%, compared to the national average 4.8%. Whereas the national inflow of FDI in China has been significant, the amount of foreign investment reaching Hangzhou in the past years is overwhelming (**Table 6.8**).

Table 6.8: FDI in Hangzhou compared to China(RMB)

	FDI as % of GDP		FDI per capita	
	China	Hangzhou	China	Hangzhou
1985	3.7%	3.9%	32	65
1990	1.9%	2.2%	31	72
1991	2.9%	2.6%	55	102
1992	11.4%	22.9%	263	1,140
1993	16.7%	27.7%	498	2,007
1994	9.1%	15.8%	366	1,561
1995	8.0%	9.5%	399	1,213
2000	3.3%	3.4%	261	766
2001	3.3%	5.2%	287	1,301
2002	3.6%	7.4%	342	2,066
2003	4.5%	10.9%	472	3,572
2004	5.1%	13.1%	626	5,127
2005	5.4%	13.9%	766	6,191
2006	5.0%	16.6%	807	8,599

Source: Hangzhou Statistics Online, 2008; China Statistical Yearbook Online, 2008

The source of these foreign investments is predominantly Asia, even more than the national average (77% compared to 63%). Western European countries play a less significant role as foreign investors. It is striking that more than half of total foreign investments originates in Hong Kong. It can be largely explained by the outflow of Zhejiang businesspersons during the state socialist period to Hong Kong, Taiwan and further abroad to the USA. Unsurprisingly, Taiwan and the USA are the second and third largest foreign investors in Hangzhou. The Chinese-dominated Singapore is a good fourth. As well-documented by Saxenian (2006), these overseas Chinese have become significant investors in Mainland China, not only in terms of financial capital,

Exhibit 6.3: From Ningbo farmer to Silicon Valley hero

Min Zhu was born in Ningbo, Zhejiang Province. He received his bachelor degree from Zhejiang University and in 1985 got an MS in Management Science Engineering from Stanford University. He developed his technological expertise at the IBM Scientific Center in Palo Alto, California. In 1991, Zhu co-founded Future Labs, one of the first companies to produce multi-point document collaboration software. Quarterdeck acquired Future Labs in 1996, and Zhu went on to co-found WebEx with Subrah Iyar (general manager of Quarterdeck) in 1995. In 2004 he became a venture partner at New Enterprise Associates, where he worked practices in sourcing and evaluating new investment opportunities with a focus on opportunities in the expanding Chinese market.

On May 13, 2005, Zhu resigned from WebEx and left the United States. Cisco Systems would later, in 2007, acquire WebEx for $3.2 billion. In September 2005, NEA announced plans to back Chinese venture firm Northern Light. The new firm, founded by Min Zhu along with Chinese entrepreneurs Feng Deng and Yan Ke, share office space in China with NEA venture partner Xiaodong Jiang. In 2005, Min Zhu also founded Cybernaut Investment Consulting Company to help Chinese entrepreneurs grow up.

Zhu Min donated $10 million to Zhejiang University in 2007, and set up a non-profit organization, Zhejiang University Innovation Institute (ZII), International. Finally yet importantly, he invested in Infoware, a promising enterprise software firm that will take the WebEx business model to the next level, and which is founded by his son, Zhu Lei.

but also in bringing in relevant advanced technologies, management skills and labour. **Exhibit 6.3** provides an example of an 'overseas' investor in Hangzhou: Zhu Min.

6.8 Discussion of findings

Hangzhou has developed a local business environment with distinct features. It is one of the most prosperous regions of China in terms of GDP, income and wages. In particular, compared to the national 'average', Hangzhou has developed distinct patterns of organization of economic activities. The findings allows us to single out key features of three crucial institutional arrangements in Hangzhou: role of the local state, skill development and education and the financial system.

Hangzhou's local government works 'at arm's length', i.e. a non-intervening local government and private firms as dominant economic actors. The focus is the local development strategy is on innovation and entrepreneurship driven by the market. Furthermore, Hangzhou is home to technology development zones and incubator parks that facilitate the growth of high-tech industries, but especially 'clean' sectors such as

software, services, telecommunications, etc. The service and high-tech industries are the dominant industries, driven by innovation and market competition.

The skill development and formal education system provide incentives to entrepreneurs and become increasingly facilitating for knowledge – human capital – intensive development: monetary incentives for IT and academic jobs; social networks within sectors; elite university; supplementary training organized by associations and companies; and comprehensive elite education. However, there is still a general scarcity in competences, low geographic mobility and high workplace mobility that makes it difficult for employers to commit employees to their firm. Anecdotal evidence also suggests that the labor market is inefficient in terms of recruiting and retaining employees. The labour market has almost no coordination with the absence of unions, job agencies and the prevalence of informal recruitment. Moreover, the labour market is *locally* very fluid, i.e. high mobility across firms in the same sector.

The financial system is highly biased towards private capital and foreign investments. Increased private savings and (foreign) investments in tertiary industries provide opportunities while a low availability of bank loans and strong competition for private and foreign capital limits the effectiveness of the local financial market. The absence of a professional venture capital and banking system makes the financial market uncertain and highly competitive. It is likely that the role of informal networks for obtaining private and/or foreign capital is large. Whereas the formal banking system is highly regulated – as elsewhere in China – the informal, private banking sector is not transparent and without clear rules of the game. In a sense, the financial 'system', is highly deregulated and coordinated by market forces. However, the rules of the market are not transparent but informal agreements between different actors (private investors, entrepreneurs, networks of firms and government agencies).

Chapter 7 – Findings 2

Software innovation patterns and three empirical cases

7.1 Introduction

Hangzhou's local business system has a variety of opportunities and restrictions for firms and sectors (Chapter 6). It is useful to repeat my classification scheme of the software sectors and their expected innovation patterns in Chapter 2 (**Table 7.1**). Entrepreneurs in these sectors have different constraints on innovation caused by market and technical characteristics. These sectoral constraints in combination with the opportunities and restrictions in Hangzhou set incentives for innovation. Entrepreneurs need to explore new ways to mobilize resources, new ways of doing business, new ideas for re-combining productive factors, developing and producing new products or more efficient production technologies. The findings suggest that Chinese private software entrepreneurs indeed innovate rather than imitate and that there are distinct innovation patterns. What type of innovation do Chinese software entrepreneurs develop? The general literature sees five types of innovation, however in China we find only four: market, product, process and business model innovation.

Table 7.1 – Characteristics of software sub-sectors

	Enterprise software	Standard software	Middleware
Product/service	'Total-solution'	Novel product	Application
Customers	Few, diverse	Many, similar	Many, similar
Cost model	Service, sale	Sale, licensing	User revenues
Extent of customization	High	Low	Middle
Innovation pattern	Incremental	Radical	Radical
Locus of product change	Systemic	Stand alone	Modular
Expected risks of competence destruction	Limited	Considerable	High
Expected imitation risks	Considerable	Limited	Limited
Entry barriers	High	Medium	Low
Capabilities	Knowledge of full process; collective capabilities	Creativity; individual capabilities	Coordination, individual capabilities

While identifying patterns provides useful insights in sector-level innovation, the mechanisms at the firm level are yet to be explained. In fact, research on innovation in China usually stays at the national level (e.g. Liu and Buck, 2007; OECD, 2007), explaining developments in innovation systems (Liu and White, 2001) and analyzing latecomer strategies and technological catching-up (Li and Kozhikode, 2008). Other studies focus on specific features of innovation development, such as Batjargal's study of social capital in innovative software ventures in Beijing (Batjargal, 2007) or knowledge management in large, successful high-tech firms (Lau, Lu, Makino, Chen and Yeh, 2004). Firm level explanations of innovation mechanisms are limited to a handful of researchers, most prominently Qiwen Lu and William Lazonick's work on the computer hardware industry (e.g. Lu, 2000; Lu and Lazonick, 2001) and Shulin Gu's work on New Technology Enterprises (Gu, 1996). An empirical analysis based on extensive fieldwork interviews shows the firm level mechanisms of innovation. The chapter concludes by illustrating these with the stories of three entrepreneurs.

7.2 Patterns of innovation: empirical results full data set

This empirical study investigates different aspects of innovation (Chapter 3): type, characteristics and systemic features. The respondents indicated in the interviews that there are four types of innovation: market, product, process and business model innovation. The interviews show that there are three drivers of innovation: external technological development, customer demand and in-house firm initiative. Furthermore, it is useful to check how well the empirical findings fit the general classification scheme in the literature that distinguishes radical from incremental innovation and stand-alone, modular from systemic innovations. The last section then discusses the various connections between these features.

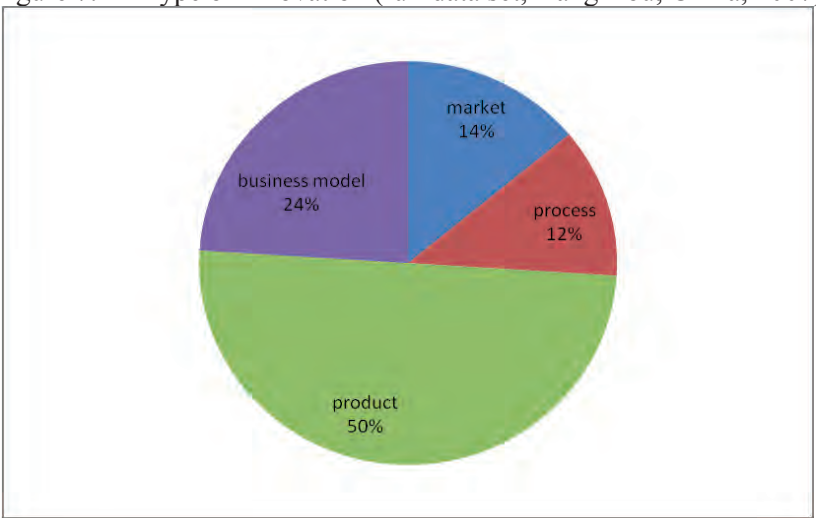
7.2.1Type of innovation (full data set)

Chapter 3 singled out 5 types of innovation: new product and methods of production, new ways of organizing the value chain, opening new markets for goods and services and new ways to organize business. The type of innovation in this study's data set is identified by combining the answers to the following questions in the interview: 'What type(s) of innovations did the firm introduce?'; 'Please shortly describe an example of an innovation that is crucial for the firm's development'. Furthermore, the answers were checked with publicly available data on the firm's product, such as websites.

The findings in the full sample of 45 software entrepreneurs suggest that, contrary to popular belief, Chinese software entrepreneurs are innovative and see the value of innovation as opposed to imitation. **Figure 7.1** (next page) shows the types of innovation in the full data set: product (50%), market (14%), process (12%) and

business model (24%) innovation. *Product innovation* is mentioned by 50% of the respondents. Product innovation here refers to new products and services that did not previously exist in the market and addresses a need that existing product could not satisfy. A generic example is a new computer game or a new CAD/CAM software package[32]. A Chinese example is Firm 36's integrated risk management software package. This product innovation was developed in response to the liberalization of Chinese financial markets and integration in global financial markets. The product integrates interest rate derivative products, pricing analysis and risk management in one package. Compared to foreign suppliers, Firm 36's software displayed a number of advantages: competitive prices, address rapid development of the capacity for the most pressing needs, customer service, provide Chinese and English interface, and provide risk assessment reports.

Figure 7.1 – Type of innovation (full data set, Hangzhou, China, 2007)



Market innovation is mentioned by 14% of the respondents. Market innovation refers to the opening up of new markets for goods and services. This does not necessarily refer to fundamentally new products or services but to new to the market environment. A generic example is the introduction of computer service software for the real estate market. A Chinese example is Firm 56's interactive communication software for business customers. Market innovation was unleashed by the firm's market research on the current state of Internet development. Over 90% of new sites are found through

[32] CAD/CAM systems integrate Computer-aided design (CAD) with Computer-aided manufacturing (CAM). Such computer tools and systems assist designers and control the manufacturing process, which increases efficiency of the manufacturing process.

search engines. However, even when customers intend to buy, they hardly ever contact the firm. The software that Firm 56 developed enables websites to talk and communicate, make it an interactive website. Combining traditional websites with the technology of the immensely popular instant messaging software, Firm 56 develop a piece of software that enables interactive websites. This next generation software will open up a completely new market for interactive websites.

Process innovation is mentioned by 12% of the respondents. Process innovation refers here to new methods of production or delivery of the service. A generic example of process innovation is the Java software platform that allows developing software across different platforms. A Chinese example is Firm's 65's quick development platform on which they can develop software more flexibly and efficiently. The software technology competences are inspired by SAP software but derived from cooperation with universities. The CEO regularly visits companies who buy SAP software and then look how they implement it. Furthermore, they developed cooperation with some domestic universities, Zhejiang Industry and Commerce University and China Polytechnic University. Interestingly Firm 65 has cooperation with Liverpool University for data mining database techniques and entered into an EU 7th framework bid last year. In short, Firm 65 is improving the development process of their software product.

However, it is especially *business model innovation* that is noteworthy. This type of innovation is mentioned by 24% of the respondents. A business model is a structural template that influences how a firm transacts with all its external constituents, such as customers, suppliers and other parties (Amit and Zott, 2007). Business model innovation then refers to novel ways of organizing the organizational framework in order to create superior value for customers, as proposed by Chesbrough and Rosenbloom (2002). Such a framework generally includes the value proposition to the customer, key processes and resources and the profit model. Many successful companies in knowledge-intensive industries have shown the value of business model innovation in US American and Western European contexts. For instance, Federal Express, Google, Xerox and Dell were built on business model innovations. A Chinese example is Firm 50's model of localizing business information. The firm developed network advertisement software that adds value by offering an attractive package and by creating maximum exposure of the advertisements.

It works as follows: customers rent an LCD monitor that they position at the entrance of their restaurant, bar or hotel. When customers rent a machine, they buy the right to have their advertisement shown in nine other places that are within walking distance. Those nine other customers have their advertisements shown on each other's

LCD monitors. Firm 50's software guarantees maximum exposure and an attractive combination of advertisements (e.g. not only restaurants or bars but also several different restaurants combined with several different bars). Furthermore, they offer a mobile Internet service that allows consumers to find customers in the network that are near their geographical position. Two complementary innovations were necessary. One innovation is a mobile GPS system, using Bluetooth technology to set up a mobile website. Another innovation is a management system that combines a client website management system with client databases. The innovations in Firm 50 cover many areas of the organization and the way the firm adds value to the customers, i.e. business model innovation.

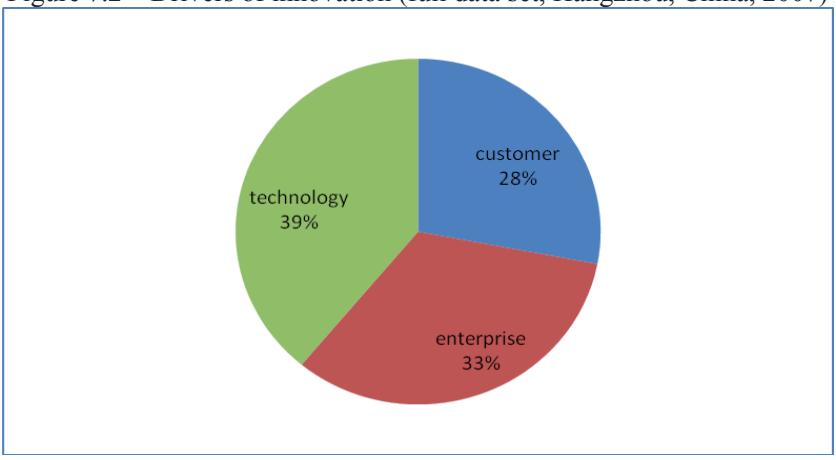
The fifth type of innovation known in the literature, *value chain innovation*, is not found in this sample. One of the reasons is that these firms are too small to be able to change and improve processes that span the boundaries of their firm and extend into suppliers and customer's firms. A lack of legitimacy and bargaining power due to newness and smallness hinder these software firms to innovate the value chain. A Chinese example of a value chain innovator is Alibaba, a large company (12,000 employees) with significant bargaining power with its suppliers and customers. By providing a dynamic online platform for e-business, they radically changed the value chain process. Small software firms are not yet able to innovate the value chain.

The findings suggest that Chinese entrepreneurs see the value of innovation *and* understand innovation in a wider sense. Namely, the types of innovation can be distinguished into organizational innovations, i.e. business model and market innovation, and technological innovation, i.e. process and product innovation. Looking at the whole data set, respondents indicate to have both organizational (38%) – and technological (62%) innovations. This reminds us that innovation is not necessarily in technologies, which is traditionally seen as 'real' innovation (Fagerberg, Mowery and Nelson, 2007). On the contrary, firms can be innovative in the way they organize their business, not unlike Western countries, where successful catching-up historically also involved innovation, 'particularly of the organizational kind, and with inroads into nascent industries' (Fagerberg and Godinho, 2007, p. 515). In this context, it's worth stressing business model innovation. Firm 50's localized business model illustrated the interplay between both forms of innovation. Henry Chesbrough's studies on US firms also suggest that some technical innovation was necessary for firms such as Google and Dell. However, the main reason that these firms have grown is that they offered customers a new way to do something that had not been offered before (Chesbrough, 2006). The results of this study show a similar process in Chinese firms.

7.2.2 Drivers of innovation (full data set)

The literature on innovation and drivers of innovation in particular, suggests a wide variety of potential drivers, ranging from technologies, employee ideas, customer requirements, user innovations to scientific inventions and commercialization of university research. Drivers of innovation here refer to the dominant source of ideas for innovation; i.e. if innovation is technology-driven it means that innovation is 'set-off' and triggered by developments in technology. Multiple drivers can trigger innovation at the same time, however, we focused on the dominant, most important driver since we are interested in identifying dominant patterns of innovation and its drivers. These patterns give us insights into how innovation is triggered across different sectors. Practically, in the interview with the entrepreneurs we asked who or what initiated the idea for the innovation (question 10) and which factors were important for the development of the innovation (question 11). These were open-ended questions to the software entrepreneurs.

Figure 7.2 – Drivers of innovation (full data set, Hangzhou, China, 2007)



The interviews show who and what drives innovation for software entrepreneurs in Hangzhou (**Figure 7.2**). The findings in the full data suggest that innovation is driven by external technological developments (39%), customer demand (28%) and in-house firm initiatives (33%). *Technological development* ('technology') is mentioned by 39% of the respondents as the driver for innovation. Technology-driven here refers to either developments within the software field or in related fields, mostly computer hardware or telecommunications, which more or less force firms to innovate. A generic example is the switch to a more advanced programming language (e.g. JAVA) as the industry standard that developers are forced to adopt and at the same time opens up possibilities for innovation. A Chinese example is Firm 82's online interactive

games, so-called 'flash-games[33]' based on new 3D game technologies. The games are being exported to Europe, the United States and Australia. Technology is crucial in online interactive games, especially in the 3D games business. These technologies are not yet as mature as in 2D or TV games. Since no standard or dominant technology emerged yet, the technologies change quickly. Game firms need to keep up to hold their competitive position. Moreover, the level of technologies used and the standards required for the foreign markets are much higher than in mainland China. Even though they can never be technology-leaders on an international level, at least they have to keep up with the other firms. Therefore, innovation is crucial and driven by developments in technology.

Customer demand ('customer') is mentioned by 28% of the respondents as the driver for innovation. Customer-driven here refers to those innovations that are either required by the customer on the basis of their experiences or the feedback and experience of customers is the basis for innovation. A generic example is the request from a customer to add certain functionality to the existing product. A Chinese example is Firm 73's software system that calculates the market value of cell phones in real time in response to the demand of customers. Faced with high 'turnover' of cell phones and quick depreciation, large businesses do not know how to depreciate cell phones on their balance sheets. This product's added value lies in the fact it allows business customers to depreciate cell phones continuously at the real value.

In-house firm initiative ('enterprise') is mentioned by 44% of the respondents as the driver for innovation. Enterprise-driven here refers to ideas from employees, managers or founders that set the incentives for innovation. A generic example is an online picture sharing platform. A Chinese example is Firm 22's localised online search engine. The business model of Firm 22 is founded with the idea that common people should be able to use the Internet world without knowledge of Web2.0, SNS, and networks. The search engine is focused at all the aspects of life: housing, jobs, education, food, drink, friendship, etc. They use a matrix with business categories (e.g house, car renting and sports) and regions (county level).

These findings suggest that there are both external – and internal incentives for firms to innovate. The external incentives (67%) arise from developments in technology and demand from customer. This has several implications: technologies are apparently developing and being upgraded to the extent that they more or less force firms to upgrade firms. Technology thus becomes a driver for upgrading firms. Furthermore, customer demand is increasingly sophisticated. At the same time, internal incentives (33%) are important compared to external incentives.

[33] Games based on flash technology: bi-directional streaming of audio and video. It is also a popular method for adding animation and interactivity to web pages.

7.2.3 Characteristics of innovation (full data set)

The literature suggests to characterize innovation patterns along two axes: incremental, radical versus stand-alone, modular, and systemic. How do the empirical finings of innovation patterns fit in that classification scheme? First, innovations can be incremental or radical, depending to what extent the core technology is different compared to the technological trajectory in the industry and to what extent the innovation involves offering substantially different product/services for customers relative to existing products/services in the industry (cf. Chapter 3). The findings show that 66% of the innovations are radical. This refers to firms striving for technological leadership and to that end innovating radically in technology, business model and opening up of new markets. Furthermore, the findings show that 34% of the innovations are incremental. This refers to incremental improvement of products and processes, upgrading service to customers and introducing more products in the same production line. So, Chinese entrepreneurs tend to develop both radical and incremental innovations.

The assessment of this distinction is made on the basis of qualitative interview data. Questions about the innovation process and investments in technology (questions 8-16) provide information about the technologies used, whereas questions about technological base and changes in the industry (questions 37-41) provide information about technological trajectories in the industry. Questions about the customers (question 32-36) provide information about the preferences and behavior of the customers that allows us to asses to what extent the product/service is valued as different. Furthermore, we asked the entrepreneurs about the investments necessary for innovation and how he assesses the innovation compared to competitor's. The more investments necessary and the more the entrepreneur considers the innovation radical, the more radical the innovation is likely to be. Altogether these assessments led to a dichotomous categorization of innovation as either radical or incremental.

Second, innovations can differ in their systemic features, i.e. from systemic or modular to stand-alone. The findings show that 22% of the innovations are stand-alone, 44% are modular and 34% are systemic. This suggests that Chinese software firms have a variety of innovations, ranging from changes in products to changes in whole systems of products. In fact, most of the innovations are not stand-alone but are linked to other elements of a technology, organization or market. Moreover, the result suggests that there is a relatively large variety of innovation found in the software industry, across the different sectors. Such variety of innovation begs the question of what kinds of capability firms have developed (see Chapter 9).

The assessment of innovations in the sample considered two aspects: switching costs and modularity. We used questions like: 'Did the firm have to change the way it produces products or delivers services?' If the firm has to change the way it produces

a product in response to certain technological changes, it is likely that the innovation is of a systemic nature, involving widespread changes (as opposed to stand-alone). 'Please explain which factors were important for the development of this innovation?' If internal factors, such as R&D and marketing project teams, are important for the innovation, i.e. if the innovation involves multiple departments, the innovation is likely to be of a systemic nature (as opposed to stand-alone). 'Did the firm have to make significant specific investments for this innovation?' The higher the specific investments the more likely it is that the switching costs for the firm are higher, indicating a more systemic type of innovation (as opposed to stand-alone). With respect to modularity, we looked at two features: first, whether or not the firm uses modules. If not obvious in direct communication, usually one look at the product provides enough evidence for the extent of modularity of the product. Second, whether or not the firm operates within certain technical standards. If answers to both questions are affirmative and the switching costs are relatively low, then it is likely that the innovation is of a modular nature.

Table 7.2 - Type of innovation versus characteristics and drivers

	Market	Product	Process	Business model	*Total*
Stand-alone	2%	**20%**	-	-	*22%*
Modular	10%	10%	2%	**22%**	*44%*
Systemic	2%	**20%**	10%	2%	*34%*
Total	*14%*	*50%*	*12%*	*24%*	*100%*
Radical	12%	**30%**	2%	**22%**	*66%*
Incremental	2%	**20%**	10%	2%	*34%*
Total	*14%*	*50%*	*12%*	*24%*	*100%*
Customer	-	**24%**	2%	2%	*28%*
Technology	7%	**24%**	8%	-	*39%*
Enterprise	7%	2%	2%	**22%**	*33%*
Total	*14%*	*50%*	*12%*	*24%*	*100%*

7.2.4 Connections between innovation type, characteristics and drivers (full data set)

Beyond static descriptions of innovation in the data set, it is useful to cross-tabulate the types, characteristics and drivers of innovation (**Table 7.2**). More specifically, it is useful to connect the type of innovation to its features in term of radical-incremental, stand-alone, modular and systemic and enterprise, customer and technology driven. In the literature, type of innovation, characteristics and drivers of innovation are strongly linked together. The data in the sample show different patterns and suggest that there are certain specific connections between driver, characteristics and type of innovation.

Modular innovation (44% of total) is the dominant type of innovation in the sample of software entrepreneurs. When we look at the type of innovation versus the

systemic features of the innovation, we can see more specifically which type of innovation is dominant. The findings suggest that the majority of innovations are stand-alone - and systemic *product* innovations (40% of total) and modular *business model* innovations (22% of total). In particular, stand-alone innovations tend to be product innovations (20% versus 2% market innovation of total) and systemic innovations are usually also product innovation (20% versus 2% market, 10% process and 2% business model innovation of total). Interestingly, the majority of modular innovations are of the business model type. The findings show that business model innovations tend to be modular (22% versus 2% systemic innovation of total), whereas product innovations are often stand-alone (20% of total) or systemic (20% of total).

Innovation in 66% of the cases in the sample of software entrepreneurs is radical. More precisely, business model and market innovations (i.e. 'organizational innovations') tend to be radical (22% and 12% versus 2% and 2% of total), whereas process innovation tends to be incremental (10% versus 2% of total). Product innovations can be both radical and incremental (30% and 20% respectively of total), i.e. there is no strong connection between this feature and product innovation. These findings suggest that both organizational and technological innovations can be incremental and radical.

When we look at the drivers of innovation we see another pattern emerging. Whereas product, market and process innovations have a variety of drivers, business model innovation is mostly driven by in-house initiatives (22% versus 2% customer driven). It is noteworthy that product innovations usually are not driven by such in-house initiatives but by customer or technological factors (both 24% of total), exactly opposite of business model innovation. The findings suggest that business model innovation is driven by more internal factors whereas the other innovations are driven by external and/or internal factors.

The findings show that Chinese entrepreneurs do not only innovate incrementally; making small modifications, but on the contrary also develop radical innovations. Moreover, radical innovation is found in stand-alone settings and within modular systems. This suggests that innovation in Hangzhou is not limited to certain types but indeed takes place in a broad area. Furthermore, considering the diversity of innovation types, characteristics and drivers, it is worthwhile to emphasise the diversity of innovative activities across the software sectors. It is worth stressing that these results suggest that both organizational – and technological innovations can have radical and incremental features. This reminds us of the fact that radical innovation is not limited to technologies. Furthermore, the cross-tabulated findings suggest that product – and business model innovations have the most distinct features. Business model innovation tends to be radical and modular driven by in-house initiatives.

Product innovation can be radical and incremental, stand-alone and systemic and driven by mostly external factors (technology, customer).

Before we move on to firm-level explanations of innovation, it is useful to first go to the sectoral level and investigate whether or not we find specific patterns of innovation across the three software sub-sectors.

7.3 Patterns of innovation: empirical results for the three sectors

The findings of the comparison across the three software sectors suggest that sectors show patterns of innovation. Market innovation can be found in both middleware (20%) and standard software sectors (17%), whereas there is little market innovation in the enterprise software sector (7%). Product innovation can be found in all three sectors. Enterprise and standard software sectors show each more than half of their innovations in products. The middleware sector on the contrary has more business model innovations (53%) which are not very important in the other two sectors. Interesting is the fact that process innovation is almost exclusively found in the enterprise software sector (29%). It is worth emphasising that the three sectors are rather homogenous when we look at the characteristics of innovation (**Table 7.3)**. This suggests that the market and technical characteristics of the sectors pose strong constraints on the innovation pattern. However, we need to take a closer look at innovation within the sectors to assess the validity of that suggestion.

Table 7.3: types of innovation in total data set – comparison of sectors

	Enterprise software	Middleware	Standard software
Market innovation	7%	20%	17%
Process innovation	29%	0%	8%
Product innovation	57%	27%	67%
Business model innovation	7%	53%	8%
Radical / incremental	Incremental	Radical	Radical
Stand-alone / modular / systemic	Systemic	Modular	Stand-alone

7.3.1 Enterprise software sector

The innovative activities of the firms in the enterprise software sector can best be summarized as extensively customized software work with individual large customers, as discussed in Chapter 2. Innovation takes the form of incremental improvement of products and processes, upgrading service to customers and introducing more products in the same production line. Examples of products are ERP software, risk management software, development platforms, e-conference software and electronic maps. The findings show that innovations are incremental and systemic. Innovation takes the

form of product innovation in 8 out of 14 cases (57%), process innovation in 4 cases (29%), market innovation in 1 case (7%) and business model innovation in 1 case (7%). Innovation is driven by customer demand in 10 out of 14 cases (71%), technological developments in 2 cases (15%) or in-house initiatives in 2 cases (14%). It is useful to cross-tabulate the type of innovation and the drivers (**Table 7.4**).

Table 7.4 – Enterprise software: drivers versus type of innovation

	Market	Product	Process	Business model
Customer	-	**57%**	7%	7%
Technology	-	-	15%	-
Enterprise	7%	-	7%	-

Innovation in the enterprise software sector is predominantly customer-driven product innovation. Furthermore, a considerable amount of process innovations is being undertaken by enterprise software firms both out of necessity of customer demand (7%) and external technological development (15%) as from in-house initiatives (7%).

Table 7.5: innovation pattern in Hangzhou's enterprise software sector (14 cases)

Resp	radical / incr.*	stand-alone /modular/ systemic	Type	Driver of innovation	Innovation
4	incr.	Systemic	Product	customer	additional functionality
6	incr.	Systemic	Product	customer	new ERP product
12	incr.	systemic	Product	customer	management control system
19	incr.	systemic	Process	technology	new web scripting engine
38	incr.	systemic	Product	customer	Risk management software
52	incr.	systemic	Product	customer	document engine
54	incr.	systemic	Product	customer	integrated JIS map
64	incr.	systemic	Product	customer	higher functionality e-maps
65	incr.	systemic	Process	technology	development platform
67	incr.	systemic	Process	customer	development platform
69	incr.	systemic	Process	enterprise	platform toolkit
70	incr.	systemic	Business model	customer	improving business process
71	incr.	systemic	Market	enterprise	e-conference
73	incr.	systemic	Product	customer	web self service

* incremental

Table 7.5 summarizes per firm the characteristics, type and drivers of innovation in addition to providing an example of innovation in the firm. The sector is rather homogenous as innovations are all incremental and systemic. The results confirm the expectations of the technological regimes literature (Dosi, 1988; Malerba, 2004) that

sectors have distinct patterns of innovative activities. Moreover, the patterns show remarkable similarity with software firms in Western settings. In Western European and American enterprise software firms, previous studies also find innovation of the incremental kind, usually systemic in nature (e.g. Casper and Whitley, 2004; Ibert, 2004). It is noteworthy that even though the majority of innovation is in products, the results do not suggest a specific preference, as we find all types of innovation in this sector. Therefore in my sample I find a firm that develops new ERP software product driven by customer requirements (firm 6), a firm that improves the development process by employing a platform toolkit driven by in-house initiatives (firm 69), a firm that uses a novel way of organizing it's software development process in response to customer requirements (firm 70) and a firm that develops e-conference software for large customers thereby enlarging their market driven by in-house initiatives (firm 71).

The drivers to innovate, in contrast, are predominantly set by the customer. This is not surprising given the large extent of customization of ERP and similar types of software development. In fact, it is highly risky for enterprise software firms to innovate since most customers are not waiting for new innovative solutions. Innovation then follows customers' demands and usually is not radically different from existing technologies and has to fit the customer's 'system' that is already in place. Such system includes the platform and standards that are worked with as a radically change of such standards, languages and platforms could potentially result in compatibility problems.

7.3.2 Standard software sector

The innovative activities of the firms in the standard software sector can be summarized as mass produced software for large homogenous markets without customization of the products and services. Firms strive to be the technological leader and to that end innovate radically in technology, business model and opening up of new markets. Examples of products are CAD software for urban planning, logistics software, online interactive games and data storage software. The findings show that innovations are usually radical, whether stand-alone or modular. Stand alone innovation, by far, dominates though in 9 out of 12 cases (or 75%). Innovation takes the form of product innovation in 8 out of 12 cases (67%), process innovation in 1 case (8%), market innovation in 2 cases (17%) and business model innovation in 1 case (8%). Innovation is driven by technological developments in 10 out of 12 cases (84%), customer demand in 1 case (8%) or in-house firm initiatives in 1 case (8%).

It is useful to cross-tabulate the type of innovation and the drivers. Innovation in the standard software is predominantly technology-driven product innovation. It is noteworthy that product innovation in the enterprise software sector were exclusively customer-driven, suggesting that the same type of innovation can have a very different

motivation (though both are external factors). Furthermore, a considerable amount of innovations are market innovation, also driven by external technological developments. In general, process and business model innovations are scarce. With the exception of some product and business model innovations, the majority of innovations are driven by technological developments. **Table 7.6** shows the connections between type of innovation and driver of innovation.

Table 7.6 – Standard software: drivers versus type of innovation

	Market	Product	Process	Business model
Customer	-	8%	-	-
Technology	17%	**59%**	8%	-
Enterprise	-	-	-	8%

Table 7.7 summarizes per firm the characteristics, type and drivers of innovation in addition to providing an example of innovation in the firm. The sector is less homogenous with both stand-alone and modular innovations. In my sample I find a firm that develops animation software, a stand-alone product innovation driven by new customer demands (firm 81), while at the same time, there is also a firm that develops office automation software which is modular in nature and focuses on improvements at the process level, driven by external technological developments (firm 76). However, the majority of firms produce stand-alone innovations, driven by technological developments, such as statistical software, CAD software and games.

Table 7.7: innovation pattern in Hangzhou's standard software sector (12 cases, 2007)

Resp.	radical / incr.	stand-alone /modular/ systemic	Type	Driver of innovation	Innovation
36	radical	stand-alone	product	technology	risk management
42	radical	modular	market	technology	wireless value added service
58	radical	stand-alone	product	technology	urban planning software
60	radical	stand-alone	product	technology	Statistical software
75	radical	stand-alone	market	technology	product integration
76	radical	modular	process	technology	office automation
77	radical	stand-alone	product	technology	logistics software
80	radical	Modular	Business model	enterprise	office automation system
81	radical	stand-alone	product	customer	animation software
82	radical	stand-alone	product	technology	online interactive games
83	radical	stand-alone	product	technology	data storage technology
87	radical	stand-alone	product	technology	electronic monitoring system

It's worth noting that the main driver for innovation is technology. This is not surprising given the need for these firms to develop a unique and hard to imitate product technology. Changes in technology, either from the industry or developed by the firm, necessitate innovation by the firm. If the firm does not follow the new technology, they will easily loose out in competition. Customers are not very loyal to one provider, e.g. of computer games. This suggests peer group competition instead of market competition. These customers will therefore 'go for the new thing'.

7.3.3 Middleware software firms

The innovative activities of the firms in the middleware software sector are non-customized activities for a mass market. Innovation takes the form of new business models, new product line or opening up a new market. All the firms strive to be the technological leader and to that end undertake innovative activities that are radical in nature, i.e. distinct from existing products and technological trajectories. The interviewees indicate that innovative activity is radical and aims at developing a superior 'killer' application. The business model behind the technology is the most important factor for success. Examples of products are online community software, mobile Internet applications, and interactive websites. The findings show that innovations tend to be radical and modular. Innovation is business model innovation in 8 out of 15 cases (53%), product innovation in 4 cases (27%), market innovation in 3 cases (20%) and no process innovation. Innovation is driven by in-house initiatives in 11 cases (73%) and technological developments in 4 cases (27%).

It is useful to cross-tabulate the type versus drivers of innovation (**Table 7.8**). Innovation in the middleware sector is predominantly enterprise-driven business model innovation. It's noteworthy that business model innovations in this sector are exclusively driven by enterprise, in-house initiatives, similar to standard software firms. Furthermore, enterprise-driven market innovations and technology-driven product innovations are being pursued. There is no process innovation and none of the innovations are driven by existing customer requirements or new customer demand.

Table 7.8 – Middleware: drivers versus type of innovation

	Market	Product	Process	Business model
Customer	-	-	-	-
Technology	7%	20%	-	-
Enterprise	13%	7%	-	**53%**

As in the other sectors, the results suggest that the type of innovation is not necessarily 'bound' to the sector or characteristics of innovation. Even though one type – in this case business model innovation – is dominant, it is not exclusive in the sector. In my

sample we find product innovations such as the new stock analysis software driven by technological developments and opportunities (firm 45) and market innovations such as the interactive website tool developed by firm 56 which opened up a new market rather than innovating a product (the technologies and business model already existed in alternative forms such as QQ and Taobao) by recombining existing knowledge and applying it in a new context.

Innovation in this sector seems to be more indigenous, i.e. from new ideas from the founders to create new ways to add and deliver value to an existing or new market. The findings suggest a strong relationship between the characteristics of innovation – e.g. radical and modular – and the drivers for innovation – e.g. enterprise driven. **Table 7.9** summarizes per firm the characteristics, type and drivers of innovation in addition to providing an example of innovation in the firm.

Table 7.9: innovation pattern in Hangzhou's middleware sector (15 cases, 2007)

Resp.	radical / incr.	stand-alone /modular/ systemic	Type	Driver of innovation	Innovation
13	radical	modular	market	technology	wireless platform
18	radical	modular	Business model	enterprise	e-city search platform
22	radical	modular	Business model	enterprise	local search
28	radical	modular	product	enterprise	interactive websites
34	radical	modular	Business model	enterprise	Community platform
39	radical	modular	market	enterprise	mobile GPS
45	radical	modular	product	technology	stock analysis
46	radical	modular	product	technology	embedded mobile phone backup
49	radical	modular	product	technology	mobile Internet
50	radical	modular	Business model	enterprise	advertising platform
56	radical	modular	market	enterprise	interactive websites
66	radical	modular	Business model	enterprise	Community platform
68	radical	modular	Business model	enterprise	Portal platform
78	radical	modular	Business model	enterprise	integrated search networks
86	radical	modular	Business model	enterprise	pricing information

Summarizing, innovation in the enterprise software sector is predominantly customer-driven product innovation. The sector is relatively homogenous as innovations are incremental and systemic. It is noteworthy that even though the majority of innovation is in products, the results do not suggest a specific preference, as we find all types of innovation in this sector. Innovation in the standard software is predominantly technology-driven product innovation. The sector is less homogenous with both stand-alone and modular innovations. It's worth noting that the main driver for innovation is

technology. Innovation in the middleware sector is predominantly enterprise-driven business model innovation. It's noteworthy that business model innovations in this sector are exclusively driven by in-house initiatives, similar to standard software firms. As in the other sectors, the results suggest that the type of innovation is not necessarily 'bound' to the sector or characteristics of innovation. Innovation in the middleware sector seems to be more indigenous, i.e. from new ideas from the founders to create new ways to add and deliver value to an existing or new market.

Until now, the level of analysis was the sector, which provided us with insights in the patterns of innovation and connections between type, characteristics and drivers of innovation across and within software sub-sectors. However, to gain understanding of the innovation process I will now turn to the firm as the unit of analysis.

Table 7.10: summary of three empirical cases

	RiskSuite	InfoStore	E-Net
Sector	Enterprise software	Standard software	Middleware
Characteristic of innovation	Incremental, systemic	Radical, stand-alone	Radical, modular
Type of innovation	Product	Product	Business model
Driver of innovation	Customer	Technology	Enterprise
Strategy	First-mover	Localization of technology	Localization of information
Response to opportunities caused by	Institutional change: liberalization of financial markets	Local government support: Development Zones, returnee support	Institutional incompleteness: Information asymmetry in market knowledge
HRM focus	Employee commitment; fluid local labour market	Recruitment due to scarcity of skills	Innovative culture due to employee-driven innovation
External partners	Domestic and foreign firms	Domestic and foreign firms; local university	Local government and domestic firms

7.4 Three empirical cases

The three cases[34] are illustrations of the innovation processes that were dominant in each sector (**Table 7.10**): customer-driven product innovation of an incremental-systemic nature for the enterprise software sector, technology-driven product innovation of a radical, stand-alone nature for the standard software sector and enterprise-driven business model innovation of a radical-modular nature for the

[34] The names of the companies and interviewees are not the real names.

middleware sector. These three cases also illustrate the three kinds of drivers of innovation (i.e. technology, customer and enterprise) and three kinds of characteristics (stand-alone, modular and systemic). Therefore, these three cases provide valuable insights in distinct innovation processes and are illustrative for the three sectors.

7.4.1 Example enterprise software: RiskSuite (Case 38)

Mr. Gao founded RiskSuite in Hangzhou to developed applied risk management software. The company is founded in September 2004 and it began to operate in November. So far there are 20 employees in the company in the Shanghai, Hangzhou, Shenzhen and Beijing offices. The investment of the company comes from Mr. Gao and partners. The total investment so far is 2 million RMB. They developed the first quick development platform for financial risk management in China. This innovation provides RiskSuite a competitive advantage in an emerging market. Mr. Gao got his competences from Zhejiang University (BSc, MSc International finance), engineering and management experience in famous domestic UTStarcom and Eyeball, and extensive experience abroad as the assistant-CEO in a Canadian software firm.

Financial risk management is a newly emerging industry in China. After the liberalization of financial markets in 2005, firms could start to provide financial risk management in addition to the traditional accounting management software. RiskSuite responded to these institutional changes and lack of specific bank products by gong for risk management products. Most firms are still focused on accounting and not financial risk management, which gives RiskSuite a competitive advantage. So far, there are no more than five firms like RiskSuite in China. Although this firm is not very big it has a taken a leading position in the whole industry. However, China's financial industry also has potential challenges. As it still lags significantly compared to international standards, Mr. Gao expects many changes and increased uncertainty in the financial markets. To fight off such potential constraints, Mr. Gao tries to develop and establish the products of RiskSuite as soon as possible.

The company has ten large customers, including the Real Estate Group. The biggest project is to manage the National Investment Committee (governmental fund). The Committee's 140 billion RMB is managed by RiskSuite's software. This project will give them a revenue of about 20-30 million RMB. The other big project is a new project from Insigma that they are still negotiating. The biggest competitor for RiskSuite is Yongyou Software. This company exists for 15 years and it takes a big advantage over the firm in terms of scale, investment and technology. It has a good brand reputation. But the biggest setback of Yongyou Software is that they have too many diversified businesses. They put too much emphasis on the traditional accounting field; they don't have much experience in financial risk management. They

lack core technology in this field, especially the flexible and quick development platform that RiskSuite developed.

The quick development platform for financial risk management is RiskSuite's main innovation. The product is very specialized and not very easy to imitate. Although the company is very small, it is still the number one in the domestic market. With the heavy competition, the strength of the competitors is increasing, but they have a one year first mover advantage. This innovation acknowledges the importance of financial risk management instead of traditional accounting and developments in technology. According to Mr. Gao, satisfying the customer's requirements is most important for successfully developing their new product. Learning from employees, other firms and especially foreign companies are the main drivers for innovation. However, Mr. Gao stressed that such learning should be done collectively, the company's development process requires everybody to pull together ideas, team spirit is very important. Mr. Gao suggested that good human resource management and external business relations are crucial for the development of innovation.

Organizational commitment is very important for RiskSuite because they need employees who are willing to invest in firm-specific skills and long term relations with customers. When they recruit new staff, the most important requirements are hard working, responsible and learning ability. At first, the founders preferred to recruit from the Finance College and Chinese Medicine College (both not Zhejiang University). The students from these colleges don't like job-hopping and are pretty stable and want to do hard work. But they also have to make sure the students have technology ability. So, when they recruit new staff, one group is usually from other firms, and some are from the universities. Mr. Gao thinks that the lack of ability will constrain the further development of the company. They have in-house training for employees. Furthermore, the firm will organize seminars to discuss, learn from each other, improve themselves and also supervise. Mr. Gao focuses on collective strength and learning for his employees. The employees are mainly in marketing, product and R&D because the firm is still in the early phase of the setup, with few managers.

RiskSuite has a variety of formal and informal business partners for each functional area in the company (i.e. product, technology, customers, marketing, service). Business partners are important for distinct purposes. For example: how did RiskSuite get the project from Signal? First, the firm believed that their biggest competitors are same sized companies. So after the firm pushed the competitors out of the industry, finally they found that their true competitor was Friend Software. Originally the project manager of Signal wanted to choose Friend because of the strength and the reputation. In fact, the project had a large possibility of failure. In case

the project fails, the PM has to have a good explanation. If they choose Friend, which can give them a good explanation, the project manager is always safe. But if they choose RiskSuite, the risk is very big, so once the project fails Signal will take more responsibility. Therefore, RiskSuite tried to make Signal realize their specialization and confidence in the project's success. The PM of this project got assurance from other projects and business contacts. Finally he chose RiskSuite for the risky project. So, RiskSuite finally beat the stronger Friend Software by use of business contacts.

The most important technology cooperation is with Microsoft. The goal of the cooperation is to draw support from Microsoft for distribution of their own products and technology. Moreover Microsoft can also help to expand the market. They have been cooperating for over a year and they meet every two or three months. The cooperation is on a project basis, they have signed contracts with certain departments within Microsoft. The most important reason for choosing Microsoft as a partner is the technology of Microsoft. Of course they also have a dominant position, but Microsoft itself is not a threat. They will not become competitors in RiskSuite's market. RiskSuite continues to use their quick and flexible development platform and incrementally improves the platform.

The case is illustrative for the enterprise software sector to the extent that RiskSuite has developed an incremental, systemic product innovation driven by the requirements of customers. RiskSuite has a few large customers which is also typical for enterprise software firms. It is noteworthy that even though the driver of innovation is a set of requirements from customers, it is also a response to changes in the institutional environment. RiskSuite responded to requirements from customers that were caused by the liberalization of financial markets. Moreover, the importance of HRM is also related to China's specific environment. RiskSuite's HRM model focuses on creating employee commitment to offset the constraints of frequent job hopping of employees. In the full data set, employee turnover is on average between 20% and 30%. Lastly, external partners are important for fighting of constraints of newness and smallness. RiskSuite has developed an extensive network of partners to jointly develop technologies. It is worth noting that these partners are both domestic and foreign firms.

7.4.2 Example of standard software: InfoStore (Case 82)

Mr. Yang is one of the four founders of InfoStore (2006). InfoStore is a software company that develops data storage management software. Mr. Yang has a PhD in engineering from Zhejiang University and moved from the USA where he had already established a software firm, SoftCore. In that case he was the only Chinese founder. After 10 years he returned to China with three of his employees from SoftCore in response to opportunities in China's emerging electronics market. Afraid of piracy,

SoftCore didn't see these opportunities in China, so Mr Yang had to found his own firm. Mr. Yang combines the experience and technological knowledge of SoftCore with local knowledge of China's market and its specific requirements. More precisely he used the blue print for the technologies developed in SoftCore but modified the technology to local demands – and to prevent IPR problems with SoftCore - and innovated the business model. The firm is located in the International Entrepreneurship Centre in Hangzhou's Binjiang district. Binjiang is the main area in Hangzhou of the National High-tech development zone. As returnees, the four founders get several benefits from the government in this district, such as office space, introduction to VC firms and tax holidays.

The data storage software is based on the belief that the most valuable asset of a modern firm is not the hardware or products but the information stored on the computers. If a laptop of a manager breaks down, you can buy a new laptop, but you cannot replace the huge value of the information lost. So their software provides storage and protection technology. Furthermore, they offer the possibilities of online backups. These are not yet provided by Infocore but can be either on online servers of the customers or outsourced to specialised firms. InfoStore provides hardware – appliances such as sets of disk drives and servers – in combination with their software. However, their core technology is the storage management software. The hardware is outsourced and standardized. For instance, they sell 100 disk drives with storage management software to an Internet firm.

They basically aim for two types of customers: high-end big customers such as banks and telecoms (especially Internet firms like Alibaba) and local governments, SMEs and educational institutions. The high-end customers have large data storage requirements. SoftCore focuses on those (international) high-end customers such as France Telecom, Alcatel, the US air force, Lufthansa, etc. InfoStore focuses on SMEs, Hangzhou local government, hospitals, universities. Basically there is no competition in the SME market because their technology is rather complex. Even though they are the front of development and are frequently copied, they do not fear their competitive position. The sales value of their products range from $2,000 to $100,000 per license, so customers do not easily accept imitations but rather go for the original. In the beginning they were actually happy that others copied their products because it also means that their products are good.

InfoStore has developed several product innovations over the past few years. This year they started working on adjusting to make the original technology fit for the Chinese market. The original technology is developed for high-end customers by SoftCore. However the approach for the SME market is rather different. SMEs generally have no resources to spend on ´data storage technology´, let alone that they have full time

employees to manage the system. The high-end customers usually have whole departments concerned with data storage. So, the high-end software is much too complicated and elaborate for the small requirements and knowledge of SMEs. The business model they use for SMEs is different from the high-end customers. So, they had to innovative their business model and technology. Basically they had to downgrade and strip the technology that it becomes simple to use and meet the (limited) requirements of SMEs. This process lasted between 6-8 months of R&D.

At the same time they were also working on other R&D projects. One of those new projects is Continuous Data Protection (CDP). This is not only new in China but also new in the world. They also started with the high-end version and then try to adapt it to the low-end market. For instance, the original technology cost about $100,000 but now they sell this product for laptops for $20. What does this software do? Basically the software makes snapshots of the whole system at certain intervals: every day, every week, etc. The main problem then is that this is extremely demanding for the hardware, i.e. needs a lot of hard disk space. InfoStore developed a new technology called ´incremental snapshot´ that is an intelligent storage technology. In this way, the software keeps track of the changes made in the files instead of copying all the whole system every time. So, every new snapshot only requires very little additional space. They have 2 patents for the technology.

Lastly they developed a storage area network (SAN). This provides a solution for hardware problems. Whereas usually the problem is when to buy what kind of hard disk, e.g. 1T or 2T or 10T? You never know what your data requirements will be in the future. Every time you replace, let´s say a 1T for a 10T, the whole system needs to be transferred. With their SAN this is not necessary. The basic structure of the system remains the same and doesn't have to be moves to the new disks. You just plug in the new hardware and it will then work completely as an USB disk. InfoStore has received several awards and funds for their innovations: "2006 Innovation storage enterprises" from the State Council Information Office and the "2007 Innovation Fund" (Zhejiang's maximum funds of 900,000 RMB). The funding plays an important role in upgrading the laboratory data hardware equipments and the introduction of high technology talent. At the same time, the companies also strengthened and drive stronger the confidence of all employees. Also in InfoStore it seems that good human resource management and external business relations play an important role.

Recruitment of new employees is rather difficult. Mostly because it is a very new field and the company is young and small. The core team – also in terms of technology – is from the USA. Biggest problem is that there are not many talents in Hangzhou. Mr. Yang was rather critical of the quality of engineers in Hangzhou; Beijing and Shanghai is much better. So they hire people with at least 6 months working

experience and mostly with a master degree. The main requirements are related to personality, motivation and active attitude. Keeping the employees is easy. They provide a very challenging and interesting environment in which engineers can fully developed. They are at the front of technological development. Moreover, all the employees own a share of the company. Mr. Yang believes it is crucial that the employees also get part of the company and the profit because they are the most important asset of the company. There is no formal training in the company. Only 3 people from the core team have really enough knowledge to train other employees but just have too little time to do this. They do use a mentor system where seniors teach juniors on-the-job.

InfoStore has three important external partners: Zhejiang University, companies and the government. They cooperate with the Zhejiang University Software College. They are the practice site for students and even have an Open Lab at the software college. Furthermore, they still maintain close contact with SoftCore in the USA. They are looking for some strategy alliance partners for developing value added service, such as IT (hardware) company, network optimization company and some other vertical-industry company. Furthermore, the government has a significant influence on the industry. However, the policies and attitude of the government are very beneficial for innovation. ´Nowhere is the government so good at promoting innovation´, as Mr. Yang said. In the USA there is a hands-off approach which gives a lot of freedom but in China the government gives a lot of active support in the form of subsidies and for instance, cheap office space. Moreover, the government organizes events for sharing ideas and communicating with other organizations. Furthermore, the government introduces VCs. At the moment InfoStore does not have VC yet, though Mr. Yang already finished a proposal. They aim for a foreign VC because they want to have an IPO in the near future. In general there are no constraints or requirements from the government in return for these benefits. InfoStore continues to improve current technologies and explore new areas of development in online data storage business.

InfoStore is illustrative for the standard software firms in Hangzhou because it innovates radically. The innovation is a stand-alone new product driven by technological developments, as is typical for a standard software firm in this sector. Several findings are worth emphasising. This firm is an example of a firm that develops high-technology. They are not copycats or slow followers of ‘advanced’ international technologies but serious innovators. The basis of InfoStore’s technology is found in the combination of partnerships with domestic firms, the leading Zhejiang University and the foreign software firm SoftCore. The partnership with the Software College of Zheda and SoftCore allows them to learn the state-of-the-art technologies, whereas the local firms provide local market information. The role of the local

government as a facilitator of innovation is also noteworthy. The active local government support for returnees, high-tech development zones and the direct subsidies and funds for technologies facilitate innovation. The case suggests that the current local institutional arrangements provide more opportunities than restrictions for innovative firms.

Furthermore, the findings suggest the advantages of a localization strategy. This firm adopted a general blueprint to the local conditions, responding to opportunities in China's emerging market. One restraint caused by the local conditions is the lack of human resources. The firm indicated to have recruitment problems and not employee commitment problems, as in the previous case. The technology focus of this firm necessitates high level employees which are in short supply. Creating commitment is generally less important for standard software firms. However, considering Hangzhou's fluid labour market conditions, InfoStore had developed a corporate governance model that involved employees more by giving them shares of the firm. This explicit corporate governance model is an example of business model innovation.

7.4.3 Example of middleware: E-Net (Case 18)

Established by Mr. Zhang in October 2000, E-Net is an investment and software firm specialized in Internet and Information Technology. The company presently operates a number of renowned Internet sites, including China's retail Industry Portal, the world's first virtual city, trading portal China's only real estate search engine and Chinese martial arts and cultural portal. Mr. Zhang started in 2001 with Linkshop, an information web provider in China's retail Industry. Linkshop targeted various departmental stores, shopping centres, convenience stores and other related entities. Currently, Linkshop has over 100,000 registered members, most of whom are large and medium- sized retail operators. The daily visiting traffic reaches up to 1,000,000.

However, Mr. Zhang found that serving the retail industry was quite limited in terms of customers, market and revenues. E-Net acquired Hangzhou Ren Jia Website, previously known as Hangzhou BBS Net in 2003. In August 2004, E-Net invested in Hangzhou Aladdin Information & Technology Company that had just one project called 'E-City' and only had a DEMO version of it. Hangzhou Ren Jia's BBS and the new E-City project were merged to accomplish the 3D-City project. As a result of the integration of technologies and knowledge between the two companies, the world's first 3-D virtual city - E-City was developed in November, 2004.

The innovative business model localized information to overcome asymmetric information. The idea of presenting the entire city in 3D helps the concentration of the information and enhances the appropriate allocation of resources. E-City is a new window for the different business aspects ranging from property, entertainment to

tourism. Simultaneously, the website is able to offer the other functions: Commercial Street Signs, Yellow Pages, Real Estate Application, Search Engine, Communication Platform, Simulated advertisement, Development of E-Business, and Website Localization. Especially the last feature is noteworthy. Every website has a domain name which corresponds to the firm's real geographic location. So, E-City is able to bring more visitors to the firm and satisfy consumer demand.

Good human resource management and external business relations also play an important role in E-Net. The firm grew a lot the last year and now has over 400 employees and attracted domestic venture capital. With respect to the strategy of the firm, he said the most important question for the firm is 'who am I?' Every employee is different and has different goals. He/she will focus on those goals. So how does the employee see the firm? As a 3D map firm? Or as a software service provider or anything else? This determines the goals and also determines in what respect the employee wants to innovate. Since these goals differ between employees the firm needs to be flexible. Therefore strategic flexibility is very important. At the moment the firm has two main products: licensing product to others and service provision. Mr. Zhang sees them as very different with different work teams, working culture, etc. and considers splitting the firm into two firms.

It is relatively easy to find new employees; they just post a vacancy on the marketplace and wait for a long time. In the end there will be always suitable people for the company, so growing in terms of number of employees is not difficult. The difficult part, however, is to create a company culture with this change from 10 to 120 employees. The strategic shift from Linkshop to E-City has had major consequences for the business model. HRM has to change, management has to change, the organizational culture changes. How to accomplish that? Looking how other CEOs manage and use social networks to attract capital and knowledge.

Mr. Zhang indicated that there are basically two types of social networks that matter for the success of his firm. One way is to establish a relationship with the government, including the Provincial Economic and Trade Commission, the Provincial Department of Information Industry and the Development and Planning Commission. The government is now promoting the development of the hi-tech industry and informatization, and they can take advantage of this to get funds and support from the government. How do they build relationships with the government? Via friends, via direct visits and presenting products but also using the Chinese way: treating officials to dinner or tea. Their company will help departments like marketing, HRM, etc. to get in contact with people working in the same areas. For instance, they introduce people from the marketing department to people working in the press,

people in the BBS department to people working in Internet Supervision. Compared with traditional industries, it is relatively easy to handle social relationship.

Another way is to foster relationship with the companies in the same industry. CEOs join a club called WEB2.0 and meet with each other nearly every month, talking about technology, management and cooperation. For instance, they cooperated with Koubei Website and another 100 websites in Hangzhou, both in reciprocal links and bundling of products. The general idea is that it is beneficial for all to cooperate, create a 'brand store' and enlarge the market. The club serves managers to jump out of the daily affairs and think at a higher level. They brainstorm every time they meet and Mr. Zhang could apply this new knowledge in the operation of the company.

The characteristics of IT industry allow such interactive and creative ways of maintaining relationships. Next to face-to-face communication, the use of MSN and E-mail to transmit messages is very efficient and convenient. Moreover, the content of the communication is really focused on products, technologies and knowledge. The IT industry has grown for less than 10 years and the relationships are quite simple. IT industry is still a young industry and there is not much knowledge accumulation, especially in managerial experience. Specifically, Mr. Zhang's firm's transformation was a result of learning from the BLOG of another company's CEO. E-Net continues to improve their HRM system and expand the E-City product to more Chinese cities.

E-Net is illustrative for middleware firms in Hangzhou as it innovated its business model radically, driven by the initiatives from the founder. Three findings are noteworthy. First of all, E-Net follows a localization strategy that is a creative and innovative way of overcoming information asymmetry. It appears that firms such as E-Net and InfoStore, which can solve information problems creatively in the Chinese market, can successfully operate and grow. Second, one of the key issues for E-Net is the management of changes caused by growth in employee numbers. Neither recruitment – such as in InfoStore – nor employee commitment – such as in RiskSuite – are issues for E-Net, as a strong HR recruitment system and compensation plan is in place. The main challenge is to define a corporate culture that allows all kinds of employees to be innovative. This suggests that employee innovation is at the core of HRM in E-Net.

Third, two types of networks matter for E-Net: local government and peer industry firms. It is worth stressing that E-Net established relationships with local provincial governments, not central or city-level government to attract localised funds and support. Furthermore, this government network is far from the political networking and bribing as often suggested and/or expected in a Chinese context. On the contrary, the government is part of the firm's functional network in which people with the same function in government and firm cooperate. It's about business, not

political influence. The other type of partner, the local Internet firms, is part of a local business association that gathers frequently to discuss business issues. This network has only one purpose: to exchange information and jointly solve management problems. The extensive use of external partners is a response to a lack of resources – market knowledge, experience, management knowledge, standards etc. –in Hangzhou's local environment.

Summarizing the three cases, entrepreneurs developed distinct strategies for innovation in response to distinct opportunities and restrictions in the business environment. The three cases differ in their strategies (first-mover, localization of technology and – information). Moreover, the sources of opportunities and restrictions are distinct: Institutional change (liberalization of financial markets) in the first case; Local government support (Development Zones, returnee support) in the second case and institutional incompleteness (information asymmetry in market knowledge) in the third case. Two features stand out across all three cases: a focus on human resource development and the importance of external partners. The three cases differ substantially with respect to the type of HR development and practices (commitment, recruitment and culture) and type and use of external partners (domestic, foreign versus government, universities and companies). These findings suggest that the three firms have developed distinct capabilities for innovation. However, three cases cannot be representative for the three sectors. Therefore, it is important to identify capabilities and the specific opportunities and restrictions in response to which they are developed across all the cases in my sample. The last two empirical chapters of this thesis will present the results in terms of constraints on innovation (Chapter 8) and innovative capabilities (Chapter 9).

7.5 Discussion of findings

Chinese software entrepreneurs *are innovative*. Moreover, it appears that Chinese entrepreneurs have a better understanding of innovation than most neoclassical economics textbooks. These entrepreneurs do not limit innovation to technological innovation but also include organizational innovation. The three sectors show distinct patterns of innovation. Innovation in the enterprise software sector is customer-driven product innovation. Innovation in the standard software is technology-driven product innovation. Innovation in the middleware sector is enterprise-driven business model innovation. The results also suggest that the type of innovation is not necessarily 'bound' to the sector or characteristics of innovation; i.e. we find all types of innovation across the three sectors with both radical and incremental characteristics.

Especially organizational innovation appears to be important as it allows entrepreneurs to open up new markets and develop new ways of organizing their

business to add value to an emerging group of affluent customers. In other words, this reminds us of the fact that innovation is not necessarily technical innovation. Moreover, the findings also suggest that both organizational and technical innovation can be radical and incremental. Innovation – radical and incremental – is not exclusively restricted by the often-mentioned weakly enforced legal IPR rights. In line with Teece (2006), there are more ways to protect and secure appropriability than only the legal patent protection.

Opportunities for innovation in Hangzhou's local institutional environment are caused by internal and external drivers. The emerging nature of the ICT market causes a lot of leeway in trying out and experimenting. Therefore, almost half of the drivers for innovation are novel ideas from the firm itself as opposed to changes in technologies or customer demands. Moreover, many innovations are responses to incentives set by institutional constraints. For instance, firms that can overcome information asymmetry – a key institutional constraint – have good opportunities for innovation, as illustrated by the E-Net case. The evidence suggests the large potential of business model innovation. Another example is the deregulation of financial markets that spurred innovation in more than one firm. This all suggests that institutional constraints – such as information asymmetry - set incentives for innovation, as argued in Chapter 3.

The three empirical cases suggest the necessity for these entrepreneurs to be innovative in order to survive in an increasingly competitive market place. It is rather clear from these cases that imitation and copying of existing software or business models will not give these entrepreneurs a competitive advantage. Secondly, the role of good human resource management is significant. Human resources are clearly the key resources for these firms and it appears complicated to recruit, retain and manage the young new employees. It is noteworthy that the emphasis of HRM systems across the sectors diverges as different responses to specific institutional constraints of the labour market. Furthermore, external partners appear crucial for obtaining business information, reputation 'deployment' and mobilizing resources. Again, the importance of external partners is a direct response to a lack of resources in Hangzhou. The networks of external partners appear to be both formal and informal and include universities, local governments and foreign- and domestic companies. The role of political capital is limited; governments have become local actors in business as opposed to firms becoming actors in politics. Lastly, the role of the founder and his experience and reputation appears to play a significant role in defining a good start of the enterprise in terms of knowledge, capital, employees and technology. Chapter 9 will present what kinds of innovative capabilities the software firms have developed.

Chapter 8 – Findings 3

Technical, market and institutional constraints on innovation

'Currently this industry is really crazy, for instance, last week was a CNII Internet industry conference with over 100 companies. There are scores of companies in the same industry in China and only five or six of them are strong. (…) Last year we were really soaring with aspirations, but now the situation is rather grave. Personally I hope there will be a freezing winter for this industry [online search engines] because that can wash out some companies.'

(Firm 34, April 4th, 2006)

8.1 Introduction

In this and the following chapter, we will take the firm as the unit of analysis to analyse innovative behaviour at the firm level. This chapter identifies constraints on innovation caused by the market -, technical - and institutional conditions of Hangzhou's local business system. On the one hand, firms face institutional constraints; on the other hand, firms face sectoral constraints. This chapter is organized as follows. First, specific sectoral – and institutional constraints are singled out from existing literature. Second, the chapter presents and discusses the results per sector based on extensive empirical fieldwork interviews. The next chapter will then identify and explain the innovative capabilities that were developed in response to the constraints identified in this chapter.

8.2 Constraints on innovation: overview of the literature

8.2.1 Technical and market constraints

As discussed in Chapter 2, the literature on technological regimes and innovation systems shows that sector with distinct technologies carry specific technical and market risks. These set specific sectoral constraints on innovation. The following presents an overview of the specifics of this argument. Attempting to keep the results comparable to existing studies on sectoral specialization and technical development in developed economies we follow Casper and Whitley (2004) by distinguishing two types of risks that are related to the technical and market characteristics of innovative activities: appropriability risk and competence destruction.

Appropriability – Appropriability summarizes the possibilities of reaping profits from innovative activities. In Teece's (1986) formulation, appropriability was determined by a static appropriability regime that was a combination of legal forces and the imitability/complexity of the technology. The legal forces comprise of patents, copyrights, trade secrets and trademarks and is strongly related to the strength of (intellectual) property rights protection in Western developed economies. The technological knowledge underpinning a firm's innovation involves various degrees of specificity, tacitness, complexity and independence and thus differs across different technologies (Winter, 1987; Breschi, Malerba, and Orsenigo, 2000). Teece's argument was that in case of weak appropriability regimes firms need to develop complementary assets, such as marketing, standards, brands and relationships, to mitigate these risks.

More recent studies suggest that the legal protection of property rights is not a prerequisite for good appropriability conditions (Levin *et al*. 1987, Cohen et al*,* 2000, and Dosi, Marengo and Pasquali, 2006). For instance, the role of supporting institutions, as formulated in the National System of Innovation approaches, and the role of finances cannot be overlooked in determining appropriability. Moreover, Teece (2006) indicates the important role of managerial choice in, for instance, determining the business model. In his words, a business model '… is the innovator's hypothesis about what customers want and how an enterprise can go about meeting those needs, getting paid well for doing so, and hopefully avoiding losing out to imitators' (Teece, 2006: 1142). In some cases, great degrees of IPR protection might even deter innovative activity due, for instance, to multiple conflicting claims, high litigation costs, and user innovations (Dosi et al, 2006).

Competence destruction – *C*ompetence destruction reflects the uncertainty of technical development in terms of the technological trajectory taken and market acceptance of the innovation. In a general understanding, innovation involves new knowledge or new combinations of existing knowledge (McKelvey, 1996). Competence-enhancing innovation 'builds upon and reinforces existing competencies, skills, and know-how' (Gatignon et al, 2002: p. 1107), whereas competence-destroying innovation 'obsolesces and overturns existing competencies, skills, and know-how' (idem). In the case that innovations require radically new skills, abilities and knowledge in the development and production of a product or service, the firm has a high risk of destroying existing competences.

These characteristics set constraints on the development of organizational capabilities (Hopkins and Nightingale, 2006; Casper and Whitley, 2004; Malerba and Orsenigo, 1993; Dosi, 1988 Parker and Tamaschke, 2005). They identify some conditions that affect the requisite competences, incentives and dynamic properties of the innovative

process (Breschi, Malerba, and Orsenigo, 2000; Kaniovski, and Peneder, 2002). However, there are strong indications that innovative activity in China's context might have additional institutional constraints on innovative activities and need to be managed by appropriate capabilities as well.

8.2.2 Institutional constraints

As discussed in chapter 3, capital, labour and knowledge are the key resources for innovation. However, private agents in a transition economy face institutional constraints on these resources caused by two problems: governance – and underinvestment problems. The former refers to the uncertainty regarding which agents are providing constraints on the use of resources, whereas the latter refers to the lack of resources. I will discuss both in more detail.

Uncertainty (governance problem) – China has weak economic institutions as a result of the co-existence of socialist institutions and newly created, market-based institutions (Krug and Polos, 2004). The institutions are not weak because they have a socialist hue, which is traditionally unsupportive of private capitalists, but because there are institutions in place coming from both the socialist era and more market-oriented institutions. Institutions are incomplete and unpredictable in the sense that they do not provide a stable institutional frame (Qian, 2000), which would reduce the uncertainty emanating from innovation (Krug and Polos, 2004). On the contrary, such uncertainty allows greater variety of organizational responses to opportunities and restrictions. The risks for competence destruction are then expected to increase because of more uncertainty regarding the technological trajectory taken and market acceptance of innovation (cf. Tushman and Anderson, 1986).

In Chapter 3 we have seen that there is considerable uncertainty regarding who provides resources, i.e. who are the key actors. We have seen that there are *other key actors* in China's institutional regime as a result of dismantling the socialist state economy: local and central state agents, business associations (business groups both formal and informal), and foreign investors. However, it is unclear how these agents operate and provide constraints. There is geographic and sectoral variation in the involvement of these key actors and the constraints they set on innovation, as discussed in Chapter 3. Moreover, competing levels of government might lead to ambivalent rules, hybrid institutional arrangements and a lack of transparency; all of which increase the uncertainty in the innovation process.

Uncertainty also arises when behaviour of key actors changes or has unclear implications. For instance, unexpected state policy changes or ambiguous local policies may scare investors and inhibit risky behaviour of firms. However, in certain new industries policy makers often cannot keep up with the developments in

technology and technology might actually dictate policy. Chinese private entrepreneurs might exploit such institutional delays and - ambiguity by moving around relatively quick and filling niches due to their small size, simple structure, agility and risk-tolerance (Tan and Litschert, 1994). However, firms might also resort to risk spreading activities like (un)related diversification, developing specific business models and strategic flexibility, creating organization-specific capabilities to offset imitation risks or develop networking capabilities to spot opportunities and resources (cf. Teece's complementary assets). Summarizing, institutional uncertainty sets additional constraints for innovation.

Lack of resources (underinvestment problem) – Lack of resources affects innovation and entrepreneurship in many ways, as discussed in Chapter 3. Entrepreneurship is affected by formal institutions such as the quality of commercial code and the strength of legal enforcement. Such institutions are mechanisms to reduce uncertainty caused by technology, competition or the market. One example is China's weak protection of intellectual property rights that depends on the strength of legal enforcement which hinders some innovating firms (Lau, Lu, Makino, Chen and Yeh, 2002, IFC, 2005). Based on Teece (1986), private agents in China that are faced with a weak appropriability regime caused by a weak legal system, are expected to develop complementary assets. In the case of brand names, for instance, firms may have to rely more on status and collective reputation of the firm instead of legal protection. This suggests that private agents in China might actually have incentives to innovate their business model (cf. Teece, 2006).

Another example is an incomplete labour market. Of course there is the general labour scarcity, i.e. availability of qualified labour as opposed to unqualified labour. Such shortage will lead to heavy competition n the factor market side. This will increase labour mobility and labour turnover in firms. Moreover, skill availability problems create uncertainty for employers as to the competences of the employee. An unpredictable and dynamic labour market leaves employers uncertain with respect to an employee's willingness to invest in one job or firm and the quality of their skills. How do employers assess their competences (Sako, 1992)? Strategies for attracting and keeping employees become crucial. One strategy is to have formal labour contracts, however, with incomplete and ill-functioning labour law enforcement, this does not provide good guarantees. Then, there are three alternatives: creating competence trust (cf. Sako, 1992); develop work arrangements that commit the employees to the firm; or use innovative corporate governance models to commit employees, all of which increase the costs for firms.

Since this study is concerned with explaining the underlying mechanisms at the firm level, it is useful to 'translate' the lack of resources to consequences at the firm

level. The literature on the liability of newness is relevant here as helps to explain the consequences of a lack of resources *at the firm level*. Studies have suggested a negative consequence of 'newness' for the newly emerging private sector (Krug & Polos, 2004). Newness is often seen as a liability referring to new organizations' general resource poverty, lack of legitimacy, and weak ties to external actors provide them with reduced capacity when competing with established players, i.e. *incomplete resources* (Stinchcombe, 1965; Teece, 1986; Aldrich and Fiol, 1994). In Chapter 3, we singled out four types of potential limitations for firms: lack of business routines, blueprint, market knowledge and legitimacy.

Summarizing, the following set of constraints affect innovative behaviour in China: market & technological constraints (i.e. appropriability risks and competence destruction) and institutional constraints (uncertainty and lack of resources).

8.2.3 Note on measurement

The measurement of these constraints is discussed and explained in Section 5.4.3 of Chapter 5 but it is useful to summarize the main points. Sectoral constraints are assessed by three sets of question about competitors (questions 27-31), customers (questions 32-36) and technology (questions 37-41). Institutional constraints are assessed by two sets of questions about institutional uncertainty (questions 42-53) and lack of resources (questions 54-57 plus questions about the key factors and challenges for successful innovation, such as questions 11 and 12). These questions allowed us to assess to whether or not firms lack certain resources and to what extent.

The intensity of constraints can range from low, limited to considerable and high. Low refers to no risks or constraints for the development of innovations (i.e. the data suggest that this factor is not identified as a constraint; i.e. no uncertainty arises from this constraint and all potential risks are manageable), limited refers to some constraints but that are manageable (i.e. the data suggest that it is noticed as a potential constraint for innovation but relatively easy managed, which means that the firm does not have to make specific efforts to deal with the constraint beyond the natural, daily ways of operating), considerable refers to constraints on innovation that require specific efforts but are within the scope of the firm to manage, high refers to constraints that pose serious risks on the success of innovation and there is a high amount of uncertainty as to how to deal with this constraint. In short, the move from low to high intensity of constraints corresponds to a move from manageable and calculable risks to high uncertainty.

The findings are presented as dominant patterns across firms in a sector, i.e. the intensity of the constraint and the reasons why these constraints have such intensity are reasons found in most of the interviews with firms. The assessment of intensity

never relied on one instance or observation in one interview, it is always based on at least 2 instances across firms in the same sector. Obviously some firms in the same sector may have the same intensity of a particular constraint but for slightly different reasons. If so, this is indicated in the following discussion. In general, where possible the direct evidence of a reason for a specific constraint is quoted in the discussion and illustrated with an example.

8.3 Empirical findings: Constraints on innovation

8.3.1 Enterprise software

The innovative activities of enterprise software firms show the following characteristics: extensively customized software work with individual large customers. Innovation takes the form of incremental improvements of products and processes, upgrading service to customers and introducing more products in the same production line (cf. Chapter 7).

Table 8.1 - Enterprise software - constraints

Constraints	Intensity
Appropriability risk	High
Institutional uncertainty	High
Lack of labour resources	Considerable
Lack of knowledge resources	Considerable
Lack of capital resources	Limited
Competence destruction	Low

The type of innovative activity in this sector carries relatively low risks for competence destruction for four reasons (**Table 8.1**). Firstly, the interviews suggested that there are few sudden and unexpected changes in technology. On the one hand, due to the relative unimportance of following state-of-the-art technologies, such as in case 4, 8 and 50. On the other hand, customers required certain technical changes which reduced the uncertainty of adopting a new technology but at the same time increasing customer-specific investments, such as in cases 2, 4, 19. For instance, firm 19, a small office network software developer, met their customer's demand to make the transition from ASP to JSP as a script engine for dynamically generated websites which entailed learning new software engineering skills[35].

Secondly, most of the technical changes in this sector are based on international developments that can be followed due to a time lag of the introduction in China. Thirdly, firms in this sector extensively customize and integrate products/services for customers' specific needs, as indicated for instance in interview with firms 4, 10, 12,

19, 52 and 54. For instance, firm 54 develops community management software for government departments. The firm cooperates with local government departments on so-called 'informatization' and e-government projects that require extensive customization. The local government department participates in the development in two stages: early in the research stage, where they propose their demands and in the second round of software development.

Fourthly, the customer base is very stable either as a result of predictable demand, such as in firms 4, 19, 50, or as a result of high switching costs for the customers, such as in firms 10, 12, 52, 54. Most firms have a few large businesses – such as Jindu, Insigma[36] - or local government departments as customers. The firms with government customers develop and maintain rather crucial parts of the software system, resulting in relatively high switching costs for departments and thus lower political risks.

The potential risks of appropriability, on the other hand, are high in this sector for three reasons. Firstly, the core technologies of enterprise firms are relatively simple and suspect to imitation, such as in cases 4, 10, 12, 19 and 50. Secondly, the market is increasingly competitive due to the low entry barriers: either state-owned firms or non-state owned firms or a mix, but all are domestic and mostly local competitors[37]. Although there are some foreign competitors on the market, they are not competing on the same local market. However, the interviews suggest that foreign competition may increase in the near future, such as in cases 6, 19, 38 and 54. Thirdly, all firms in this sector were concerned about the protection of their intellectual property rights although the interviews suggested that the firms succeeded in developing certain complementary competences, which lowers the risks but increases the coordination costs with other firms.

In addition to these technical and market risks, the enterprise software firms face constraints from the underinvestment in resources. First, locating and attracting talented employees is difficult and results in a lack of human resource capacity for the firms. For instance, firm 2; a small firm of 30 employees is recruiting at least 11 new Java software engineers with mostly BSc and in 3 cases MSc degrees in November

[35] ASP = Active Server Pages (developed by Microsoft and released in 1996); JSP = JavaServer Pages (developed by Sun Microsystems and released in 1999).
[36] Jindu Real Estate is one of China's bigger real estate development companies (http://www.jindu-group.com/). Insigma is one of China's leading high-tech software company based on applied research from Zhejiang University with registered capital of over 800 million RMB (http://www.insigma.com.cn/index_en.php).
[37] State owned: interviews firms 10, 12; Non-state owned: interviews firms 50, 52, 54, both: interviews firms 2, 6

2006 at the online job market of Hangzhou's East Software Park[38]. The larger firm 52 is recruiting over 35 new software engineers at the end of December 2006 at the Zhejiang Online Talent Market[39]. Next to an overall scarcity of high quality technical employees, there is competence uncertainty. Competence uncertainty refers to a lack of standardized competences and skills of employees. As a result of limitations in the formal education system and ad hoc in-house training, it is difficult for employers to judge the competences and skills of new but also of existing employees (see Chapter 6). The HR systems in enterprise firms emphasise stable work relations by using of formal labour contracts[40] and standardized work arrangements. One often used method of standardizing work arrangements and increasing employee commitment to the firm is by organizing in-house training. Therefore, once appropriate employees are recruited, the firms are able to keep them, as a relatively low labour turnover suggests.

Second, the fact that these small firms are recruiting so many new employees suggests that they have sufficient financial resources. In fact, 10 out of 14 entrepreneurs do not consider financial resources to be constraining their firm's development. Only 4 entrepreneurs mentioned that financial constraints might become obstacles for future growth, expansion. On the one hand, enterprise software firms have generally low requirements for financial resources. Enterprise software development usually involves the customer and requires relatively limited investments in new technology, as opposed to improving existing technology. Moreover, such technological development carries relatively limited financial risks which reduces the need to abundant financial resources, such as risk capital. On the other hand, the enterprise software firms receive considerable support from the local government in terms of funding innovative activities and subsidies for office, equipment and tax.

Third, limited market knowledge in combination with a lack of strong brands is a source of concern for firms such as 4, 6, 8, 19 and 38 and partly relates to the inability to locate and attract talented employees and target customers. Next to that, firms face coordination uncertainty. The interviews suggest that there is considerable asymmetric information in the market, where government agencies (capital), business (knowledge and labour) and universities (labour, knowledge) all have parts of information and provide access to key resources. It is noteworthy that the interviews suggest the usefulness and wide variety and high quality of university research in Hangzhou, on which much of the local firms' technologies are based. Enterprise software needs to coordinate these information sources since they need to integrate labour, capital and

[38] http://www.espark.net/funcms/espark/zhespark/JobsAndResume/JobsInfo/job_ff8080810e88723d010ea2b4d6fb01ad.html in Chinese, last visit December 15th, 2006
[39] http://c410618.zjrc.com/ in Chinese, last visit December 18th, 2006

knowledge resources for specific customers in customized products. It is noteworthy that there are extensive business networks within the enterprise software market to the effect that they function as mobilization mechanisms for resources and information. The connections within the network are often formalised in contracts or joint development programs.

However, these networks are often exclusive, i.e. not collectively accessible by any firm. These networks are non-rivalrous but exclusive. A potential alternative source for technical knowledge is the foreign firm, however, the entry of foreign firms in the strongly localized enterprise software market is slow. Moreover, even though foreign firms could provide superior technical knowledge, they lack the expertise and experience to meet the requirements of the highly customized and localized enterprise software development. Although the firms are considerably constrained by lack of certain resources, the highly competitive environment gives firms enough examples of success and failure to learn from. As a result of intense competition there are many failing firms and some firms do not have successful firms in the same sector to learn from as a result of a niche strategy, as indicated by most firms. Summarizing, the underinvestment in labour, capital and knowledge resources are posing considerable, limited and considerable constraints respectively.

The uncertainty arising from ambiguous governance of resources – institutional uncertainty – is high for enterprise software firms. First, many firms face a political risk as most of the enterprise software firms have local government agencies as customers. Again referring to the type of technical development, the highly customized nature of enterprise software development involves specific investments in individual customers. In the case of business customers this creates stable business relationships based on mutual dependence (or lock-in). In the case of local government agencies that have interests beyond economic interests, such specific investments carry a political risk. Next, one of the reasons mentioned is that after WTO access and opening-up foreign firms get increased attention and supporting legislation that hinders the development of local firms, an argument also found in the critical works of Huang (2001) and Lardy (1995) on the effects of FDI in China. More specifically, local firms are uncertain about how local policy makers will respond to increased foreign competition. China generally is behind the international standards that foreign firms might require; how will local governments respond?

Next, policy changes are unpredictable and unclear in their implications. We can distinguish two types of policy changes: software policy changes and customer's

[40] Even though every employers is obliged by law to use labour contracts, it does not necessarily mean that employers follow the agreements in practice. The private enterprise software firms distinguish themselves by 'taking the contracts serious'.

industry policy changes. In the former the changes potentially affect the strategy and could restrict technology development. However, uncertain changes in policies in the industries of the customers are just as important. For instance, firm 38 operates in the financial industry and explains that the entry to the WTO requires a lot of financial reforms which are rather unpredictable for his firm, giving rise to much uncertainty. This implies that preferential policies for software firms alone are not sufficient for facilitating the development of this industry. In sum, these firms need to accumulate strong but also flexible competences that can handle such environment, without destroying their own competences; i.e. increased competence destruction risk.

The interviews allow for a discussion of organizational responses to these constraints. We can distinguish at least three different strategies of enterprise software firms. First, the development of firm-specific capabilities. Firms try to accumulate technical capabilities that are hard to transfer to other firms. Moreover, some firms – 19 and 38 – are explicitly building organizational commitment, hiring students that are least likely to change jobs frequently. For instance, firm 38 initially recruited only students from the Finance College and Chinese Medicine College. However, this strategy made it hard to get enough employees with technological abilities and they changed this strategy and recruit new staff with the same features from other firms or universities.

Secondly, firms built customer specific capabilities: exclusive R&D for the customer, fully integrated products and extensively customized products / services. For instance, firm 8 developed an equity trade and execution system exclusively for their major US customer, which was very successful with an equity trade volume of 13.1 billion US dollars in November 2002. Thirdly, the role of the founder or CEO's personal networks is crucial for attracting customers and maintaining good relationships. An example is given by the project manager of firm 2: 'The *guanxi* of the boss and the personal attractiveness (charisma) of the boss played a crucial role in the successful founding of the firm because he could attract customers and employees'. Most of the interviewees did not specify precisely which type of network was used in what situation and for what purpose.

8.3.2 Standard software

The innovative activities of the firms in our sample in the standard software sector can be summarized as mass produced software for large homogenous markets without customization of the products and services. Firms strive to be the technological leader and to that end innovate radically in technology, business model and opening up of new markets (Chapter 6).

Table 8.2 - Standard software - constraints

Constraints	Intensity
Lack of knowledge resources	High
Competence destruction	Considerable
Lack of labour resources	Considerable
Lack of capital resources	Considerable
Institutional uncertainty	Considerable
Appropriability risk	Limited

The type of innovative activity in this sector carries considerable risks for competence destruction for four reasons (**Table 8.2**). Firstly, the developments in technology are fast and often require changes in the technologies the firm use. However, most important is not matching the state-of-the-art technologies but matching technology to the market, such as in firms 17, 42, 46 and 60. For instance, in cooperation with Zhejiang University, firm 42 developed a fast development platform for mobile phone games and data storage technology for successful game development. However, these changes are market-driven and the success of the firm depends on the marketing capability of the firm not the state of their technology. Secondly, the market is the main source for uncertainty. The market is new and customers are unfamiliar with the products which makes it a highly unpredictable market. Customers often want to try out new products and change preferences frequently. Thirdly, customers appear to show little loyalty to products although the evidence is inconclusive – firms 42 and 46 – mostly because firms find it difficult to say anything about loyalty of customers in such new markets.

The potential risk of appropriability, on the other hand, is limited in this sector for four reasons. Firstly, the core technology of most of the products – for instance in firms 17, 36, 42 and 58 - is developed over a longer period of time with significant capital and human resource investments, resulting in a relatively hard to imitate and complex product. Secondly, the potential competition in this sector is strong, from both domestic and foreign firms, such as in firms 17, 36, 42 and 46. Thirdly, however, the current environment is still one with few real competitors which facilitates the use of pioneering strategies to create first-mover advantages, such as in cases 36, 58 and 60. Fourthly, the risks of a weak appropriability regime seem to be acknowledged by most firms. However, such risks are not considered to be of central concern for these firms. On the one hand, the firms are very aware of this environment, especially operating in the software business so their strategies consider and acknowledge these risks from day one and focus on mitigating such risks. For instance by developing complex, hard to imitate core technologies and/or create first-mover advantages.

In addition to these technical and market risks, the firms face constraints from the underinvestment in resources. First, new standard software firms have a relatively low legitimacy in labour markets and face a general scarcity of technical employees. Considering the attractiveness of foreign firms (cf. Chapter 6) and large firms for graduates and experienced employees, new small firms in relatively risky private software business do not often provide an attractive offer for job hunters. Small software firms lack reputation (i.e. being new) and lack a clear 'evidence' of success (i.e. most firms have limited revenues or none at all). Combined with the relatively high failure rates of these firms, it is not surprising that the preference of job hunters is on stable large (foreign) firms. Especially foreign firms have more legitimacy to compete for talented employees. Foreign firms offer better conditions, higher salaries and more status. The interviews suggest that attracting suitable employees – e.g. technical specialists – is one of the major obstacles for developing innovations. In contrast to enterprise software firms, standard software firms know how to locate human resources but lack sufficient finances and credibility as a suitable employer. Moreover, interviews suggest that standard software firms have problems developing routines, gaining market insights and developing and managing technological skills. One of the consequences is a high labour turnover of an overage 20-30% per year.

Second, new standard software firms have a relatively low legitimacy in financial markets. The lack of legitimacy plays a role here because the interviews suggest that new, inexperienced firms have trouble getting investments. Considering the relatively underdeveloped formal financial market, i.e. hard to get bank loans (Chapter 6), legitimacy and reputation are important to attract private capital or foreign capital. Even though this does result in considerable constraints in the start-up and early growth phase, only 3 of the enterprises mention that access to capital might become an obstacle for future growth. Standard software firms require large initial investments to start and commit themselves to R&D necessary for developing radical, break-through innovations. One of the constraints on acquiring these initial investments is the lack of diversity in financial sources. Basically, standard software firms have to rely on private capital, which is abundantly available and complement it with the funds and subsidies they get from for instance Technology Zones. Given their smallness and lack of alternative means of finance, the firms face considerable constraints of financial capital in the early phases of their history.

Thirdly, most firms in the sector have very few similar firms to benchmark or imitate. They are 'desperate' for learning skills from anyone available, suggesting that management skills are a key issue, such as in firms 17, 42, 46, 53 and 60. The interviews suggest that the firms lack marketing skills, more specifically, the management and use of brands. The industry in general is too young and dynamic to have built up a collective memory and knowledge of markets, technologies and

management. As in the enterprise software sector, extensive informal business network operate as informal mechanisms to overcome such constraints. In contrast to the enterprise software sector, networks in the standard software sector do not focus on mobilization of resources only but also on coordination of resources. The connections in the network are both informal and formal. Similar to the enterprise sector, this leads to – an even greater extent of – exclusive use of certain resources for a specific groups of economic agents. It is noteworthy that university research plays a significant role in providing knowledge resources, similar to the enterprise software sector. One remaining issue is the scarce IPR protection that constrains firms' strategic decisions. In contrast to developed economies, where IPR regimes for standard software are relatively strong, firms in China face the issues of weak IPR protection, resulting in higher appropriability risks. Summarizing, the underinvestment in labour, capital and knowledge resources are posing high, limited and high constraints respectively.

Additional institutional constraints are caused by uncertainty of policy changes. In addition to changes in current policies some firms are uncertain how the policy environment will respond to the expected increase in competition from both domestic firms and foreign firms, a concern also found in the enterprise software sector. Moreover, the implementation of policy (changes) appears to strongly affect the behaviour of firms. The effect of the policies seems unpredictable due to the local implementation of policy. For firm 60, the general implementation of preferential policies initially had negative effects due to the lack of support of the local government for his firm. Respondent 58 mentions the unpredictable implementation of laws, for instance in cases of bankruptcy.

The regulations are constantly changing and firms must invest to follow these changes. The regulations only appear supportive but – in combination with high implementation costs – stimulate standard strategies and behaviour of firms. In contrast to promoting innovation, it promotes homogeneity in products and development processes. The general legislation on standard software seems sufficient – in contrast to the lack of a stable general frame in the enterprise software sector – as indicated by the interviews. However, the policies are too general to be useful and are more intentions rather than clearly implemented guidelines, as is the case with the policy for supporting university student entrepreneurship that actually does not exist in practice. Furthermore, the preferential tax policy for software firms has many requirements, such as a high annual turnover, which favour large firms instead of small, entrepreneurial firms. However, it must be noted that in many other cases, for instance in technology policy and market policy, the lack of regulation opens up possibility for innovation. In short, the preferential policies often are not implemented

to their full purpose but at the same time a lack of 'constraining' technology policies opens up opportunities.

We can distinguish at least two different strategies of *standard software firms*. Firstly, a flexible strategy to exploit opportunities in the market as soon as they arise. We see strong market-driven innovation in firms 17, 36, 42, 46 and 53. Sometimes strategic redirection involves extending to other locations to be closer to the market and benefit from government relationships, as was the case for firms 17 and 42. Furthermore, the firms pursue a first-to-market strategy to have first-mover advantages (Lieberman et al). Such strategic flexibility is often found in emerging economies (e.g. Wright et al, 2005; p. 8) and seen as short-term opportunistic behaviour (Manolova and Yan, 2002; Tan, 1996) of innovating firms in emerging economies of Eastern Europe and China, mostly intended to achieve first-mover advantages (Lieberman et al; Tan, 2001).

Secondly, pursued by all standard software firms in our sample: networking for human, financial and technical resources. Firms have strong personal networks to cooperate on technology development; e.g. firm 17's CEO network or firm 53's use of its connection with Zhejiang University and Insigma Group firms. Furthermore, developing and maintaining relationships with government officials is crucial for firms 46 and 60 to benefit from preferential policies and attract a customer base. In general, a strong relationship with the local government, university or any large investor limits all kinds of risks considerably, as seen in firms 17, 53, and 60.

8.3.3 Middleware

The innovative activities of the firms in our sample in the middleware software sector can best be summarized as non-customized work for a mass market. Innovation takes the form of new business models, new product line or opening up a new market. All the firms strive to be the technological leader and to that end undertake radically innovative activities. The interviewees indicate that innovative activity is radical and aims at developing a superior 'killer' application. The business model behind the technology is the most important factor for success (cf. Chapter 6).

Table 8.3 – Middleware - constraints

Constraints	**Intensity**
Competence destruction	High
Appropriability risk	Limited
Lack of labour resources	Limited
Institutional uncertainty	Limited
Lack of knowledge resources	Limited
Lack of capital resources	Low

The type of innovative activity in this sector carries relatively high risks for competence destruction for three reasons (**Table 8.3** previous page). Firstly, the developments of software in this sector are strongly dependent on technological changes such as such as the transition from 2.5G to 3G platforms for music and video applications, and three-dimensional applications in websites, such as in firms 13, 18, 22, 45, 47 and 51. In general, the development of technology is fast, so fast that the university cannot keep up and firms resort to industry coordinated development, as illustrated by the so-called Web 2.0 club in Hangzhou with CEOs from the major search engine software developers. Whereas the other sectors technology is still developed by state institutes and universities, in the middleware sector it depends on foreign trends and coordinated industry development.

Secondly, the demand of customers is rather uncertain and hard to predict. Although the potential market is large, interviews suggest that the customers are very young and inexperienced with the Internet, making it hard to predict market acceptance. Thirdly, there is much uncertainty about technical standard setting which is done by the government instead of the industry (cf. Casper and Whitley, 2004). Most recently firms are unsure which 3G telecom standard will be assigned to which service provider. They have developed partnerships with state-owned telecom firms in order to get access to large markets and information about standards, not for coordinating technical development.

The risks of appropriability, on the other hand, are limited in this sector for two reasons. Firstly, most firms do not use very complex technologies but complex, unique business models. Radical innovative activity in this sector is in terms of opening up new market with innovative business models, in contrast to technological innovations. For instance, firm 18's combination of an acquired BBS community customer base with the E-City brand name – a popular 3D online digital city plan, also acquired – is a unique model. Firm 22, in contrast, chooses to present itself as a service with traditional values and diversity focusing on localized search capacities. Secondly, we have to note that most firms expect an increase in foreign competition – such as Google and Yahoo – that might hinder appropriability of innovation rents, as suggested by firms 13, 22, 34, 47 and 48.

In addition to these technical and market risks, the middleware firms face constraints from the underinvestment in resources. First, attracting and managing human resources is a problem for firms. Consistent with the other sectors, there is a scarcity of technical employees. This suggests that there is an overall scarcity of qualified labour in the whole software industry in Hangzhou, as expected from the aggregate data in Chapter 5. However, it is not considered a strong constraint on the

development of innovations. One specific result stands out. As opposed to formal labour markets with labour agencies, standardized competences and trustworthy education systems, the interviews suggest that labour mobility in the middleware sector is efficiently coordinated via informal – personal – labour markets. Networks of firms keep track of the qualities of their employees and how well they match the firm's requirements. If they appear match, firms will often suggest employees to move to a firm that is within the partner network. These networks are substantial and include several dozen if not more than hundred firms. As far as my data suggests, this kind of resource sharing is only found within the middleware market. It is not entirely surprising considering the coordinated efforts necessary for innovation and development in the middleware business.

Moreover, the results for underinvestment in capital goods suggest roughly the same as in the enterprise software sector. Only 4 out of 15 entrepreneurs indicated that financial goods might pose constraints. The interviews suggest three reasons. First, there is a relatively low need of financial capital. As opposed to enterprise firms, which need long term commitments, and standard software firms, who need large initial investments for R&D, middleware firms are not capital-intensive at all. Second, the abundance of personal capital and venture capital suffices to fulfil the capital needs. Last, also these firms receive additional local government subsidies in the form of office space and tax rebates.

Furthermore, there are limited constraints of underinvestment in knowledge. On the technology side, firms collectively follow international standards and technical developments. The firms are relatively weak in technology development. The adaptation of foreign technology with the use of R&D partnerships with universities provides the firms with enough technical resources. The middleware firms seem to draw on a collective local knowledge of the local business environment. The collective dimension of such knowledge is caused by the presence of extensive business networks that coordinate business information. Again, these networks are diverse and often overlapping, resulting in extensive information distribution among local firms. These networks often include major state-owned enterprises such as local telecom firms. The majority of firms see the presence of telecom operators in Hangzhou and the extensive networks of these middleware firms as a way to mitigate risks of uncertain policy changes and standard setting insecurity. For instance, via early information sharing, as indicated by firms 39, 48 and 49. Summarizing, the interviews suggest limited problems of underinvestment in resources.

The constraints caused by uncertainty are limited as well. The firms are not burdened by a large, conservative bureaucracy, can easily establish new networks and expand

networks using modern technologies such as e-mail, MSN, QQ and blogs[41], have enough examples of success and failure in the industry and have limited HRM issues due to their smallness. In general, the role of coordinated development and cooperation within the industry – and little involvement of the government – seems larger than expected. Middleware is an emerging industry, with little direct regulation (mostly indirect via telecom operators). Secondly, there have been considerable changes in policies, such as the earlier mentioned 3G telecom policy and changes in media laws that affect firms such as online advertisement and broadcasting firms 26, 28 and 50. However, the interviews suggest that these policies often follow technical changes instead of influencing technical development[42]. Summarizing, little state interference, newness and incapability of the government apparatus to follow advanced technological changes limit the institutional constraints.

We can distinguish at least three different strategies of *middleware firms*. Firstly, firms in this sector innovate radically in business model or market entry strategy. The technical standards are very broad and allow much flexibility in innovation and experimentation. These modular systemic features characterize all middleware firms in our sample. It appears important to attract a certain customer base – which is relatively difficult – and then create some sort of lock-in via continuous improvements or specific investments. In general, experimentation and managerial opportunism (cf. Wright et al, 2005; p. 9) are wide-spread in this sector, as indicated in interviews 22, 34, 13, 46, 49 and 56. Managers of these firms are risk-takers and appear tolerant of ambiguity, which is earlier found in studies on risk taking behaviour of entrepreneurs in China by Tan (2001). Such risk-taking behaviour is accompanied by pioneering strategies, first-mover-advantages, and rapidly changing strategic directions. Firm 13's Mobile Enterprise Gateway, firm 28's podcasting[43] software, and firm 45's negotiable securities online business are pioneering products that benefit from being first-movers.

Second, the interviews with firms 13, 18, 22, 28, 34 and 56 suggest that they use networks for knowledge accumulation with other firms in the industry and do not necessarily rely on university or R&D institute research. More important, there appears to be little connections to the (local) government. Firms 18, 22, 28 are in the so-called Web 2.0 club of CEOs and exchange ideas and solutions to technical problems. Entry into the club is easy and the contacts between the members are frequent but all related to the industry and mostly impersonal. Furthermore, the goal is

[41] MSN and QQ are popular free instant messaging computer programs in Mainland China. Blogs are user generated websites where entries are made in journal style and often take the form of personal online diaries.

[42] Interestingly, most of the interviewees do not worry about (changing) rules and regulations.

to create a common stock of brand names and technologies to popularize Internet use. Information is often shared via blogs on the websites of the CEOs on which discussions take place. Furthermore there are meetings that take the form of parties in which new members are introduced and partnerships forged. The personal networks are also instrumental in learning management skills from each other. The networks usually evolve around the CEO/founder and are often already formed before the firm started operations, especially in the middleware sector (compared to other sectors).

8.4 Discussion of findings

Technical, market and institutional conditions constrain to a varying extent innovation of Chinese software entrepreneurs in Hangzhou. Private software entrepreneurs in a transition economy face the additional problems of lack of resources and the uncertainty of the governance of these resources. The findings in this chapter confirm that software sub-sectors have distinct competence destruction and appropriability risks, based on distinct characteristics of different innovative activities. I also find evidence for the role of institutional constraints. Institutional constraints have diverse effects on innovation across distinct software sectors. The differential effects of institutional risks might be explained by the differences in required resources for the various innovative activities. Not all firms face the same institutional constraints, even if they operate in the same institutional regime. **Table 8.4** provides a comparison of the findings: sectoral and institutional constraints.

Table 8.4 – Comparison of findings: sectoral and institutional constraints

Constraints	**Enterprise software**	**Standard software**	**Middleware**
Competence destruction	Low	Considerable	High
Appropriability risk	High	Limited	Limited
Lack of labour resources	Considerable	Considerable	Limited
Lack of capital resources	Limited	Considerable	Low
Lack of knowledge resources	Considerable	High	Limited
Institutional uncertainty	High	Considerable	Limited

It is useful to compare the findings with respect to institutional constraints across sectors. First, the findings across the three sectors suggest that scarcity of qualified labour is a key constraint of underinvested labour resources. However, in contrast to the competence uncertainty of enterprise software firms and foreign competition for labour in the standard software sector, the middleware sector has developed an alternative informal labour market. Second, the findings for capital resources suggest

[43] A podcast is a media file that is distributed by subscription (paid or unpaid) over the Internet using syndication feeds, for playback on mobile devices and personal computer.

that enterprise software and middleware firms have relatively low capital needs, whereas standard software firms have strong needs for initial R&D investment. All three sectors receive considerable local government support in the form of subsidies and tax cuts. Furthermore, where constraints on capital for enterprise - and standard software firms arise in the limited availability of long-term finance, middleware firms face no such constraints as the provision of personal and venture capital is sufficient. Therefore, the middleware firms have a competitive advantage over the other sectors and are more likely to be successful in attracting necessary capital resources.

Third, the findings suggest that enterprise software and middleware firms lack a collective memory and have limited market knowledge as opposed to middleware firms. They have an advantage of strongly localized knowledge. Next, all sectors have extensive business networks that differ in level of formality and governance mechanism. Next, foreign technology plays a role for enterprise software and middleware firms but not for standard software firms. Lastly, university research appears to be a strong collective resource across the sectors. Fourth and last, middleware firms do not face political risks as they operate relatively independent from the government as opposed to enterprise and standard software firms. These last two sectors have frequent interaction with local government agencies either because they are customers or important business partners. However, enterprise software firms seem to be most influenced by policy considerations. In general, the enterprise sector is more regulated than the other two sectors. The interviews in the other two sectors do not seem to indicate that this is a problem but opens up possibilities. Even to the extent that technology and market is dictating policy instead of the other way around, as is the case in the middleware sector.

The interviews suggest several general strategies that firms in the respective sector tend to follow. Enterprise software firms develop firm-specific and customer specific capabilities while employing the personal networks of the CEO maintain customer relationships. Standard software firms generally are more flexible using networks to exploit market opportunities. Middleware firms are even more flexible, usually employing first-mover strategies and focus on knowledge resources. These strategies are general directions and it is important to understand what kind of capabilities firms develop to mitigate sectoral and institutional constraints in order to innovate; be they specific for customers, the firm, focused on networks and or for specific strategic purposes. The next chapter will show the findings with respect to these capabilities. **Table 8.5** (next page) summarizes the main strategies to deal with sectoral and institutional constraints per sector.

Table 8.5 - Strategies for dealing with sectoral and institutional constraints (per sector)

Enterprise software
1) Developing firm-specific capabilities that are difficult to imitate: technical capabilities and organizational commitment
2) Building customer-specific capabilities: exclusive R&D, integrated products/services and extensive customization
3) Employing CEOs' personal networks: attracting customers and maintaining relationships
Standard software
1) Employing a flexible strategy: exploiting market opportunities
2) Networking for human, financial and technical resources
Middleware
1) Innovating radically: experimenting with business model or market entry strategy
2) Employing first-mover strategy: pioneering and rapidly changing strategic directions
3) Networking for knowledge within industry

8.4.1 Benchmarking the results

It is useful to compare my results with Casper and Whitley (2004) because they also analysed the connection between institutions and technological risks for the software sectors. The managerial constraints seem to follow the general pattern of the software industries in Sweden, UK and Germany but for different reasons. Obviously, Hangzhou's institutional regime is different from those of Sweden, UK and Germany. The key differences are in the coordination mechanisms for critical resources. In Chapter 6 I argued that with respect to the labour market in Hangzhou there is a general scarcity in competences, low geographic mobility and high workplace mobility that makes it difficult for employers to commit employees to their firm. Furthermore, the labor market is inefficient in terms of recruiting and retaining employees. The financial system is highly biased towards private capital and foreign investments. Increased private savings and (foreign) investments in tertiary industries provide opportunities while a low availability of bank loans and strong competition for private and foreign capital limits the effectiveness of the local financial market. Germany on the other hand has a relatively strongly coordinated financial and labour market, with powerful trade and industry associations and labour organizations that coordinate the labour mobility. Again different is England's liberal market. Financial and labour markets are largely deregulated and have little room for collective actors such as unions.

The enterprise software sector faces low competence destruction risks because there is high customization but also by following foreign trends. The sector has high

appropriability risks due to intense competition but also due to weak IPRs and mostly local domestic competition. The standard software sector has high competence destruction risks because of the technical uncertainty but also due to the unfamiliarity of the unskilled customer. Firms have low appropriability risks because of the technical complexity but are also limitedly constrained by weak IPRs. Middleware firms indeed face high competence destruction risks due to uncertainty about standard setting, but not by the industry but by the government. Lastly, middleware firms have low appropriability risks due to complex technology but also face limited constrains from weak IPRs. They indeed innovate radically but in business model, often following existing technologies developed in the US. In combination with the insights from our analysis of liability of newness and institutional uncertainty, this study provides insights in how the Chinese software sectors are different from the European counterparts (**Table 8.6**).

Table 8.6 – Comparing Casper and Whitley (2004, Europe) with this study (China)

	Enterprise software		**Standard software**		**Middleware**	
Constraints	*This study*	*C&W '04*	*This study*	*C&W '04*	*This study*	*C&W '04*
Competence destruction	Low	Lim.	Cons.	High	High	High
Appropriability risk	High	Cons.	Lim.	Lim.	Lim.	Lim.
Lack of labour resources	Cons.		Cons.		Lim.	
Lack of capital resources	Lim.		Cons.		Low	
Lack of knowledge resources	Cons.		High		Lim.	
Institutional uncertainty	High		Cons.		Lim.	

Lim. = limited, Cons. = considerable

Chapter 9 - Findings 4

Developing innovative capabilities

9.1 Introduction[44]

Chapter 7 provided empirical evidence that Chinese entrepreneurs are innovative. Chapter 8 showed how sectoral and institutional constraints pose constraints on private software entrepreneurs. Entrepreneurs need to develop innovative ways for fighting off these constraints. Then the question arises, what are the underlying mechanisms of their innovative behaviour and how do they fight off sectoral and institutional constraints? The discussion in Chapter 8 suggested a variety of strategies to deal with these constraints. This chapter presents an empirical analysis of innovative capabilities based on extensive interviews with Chinese software entrepreneurs in Hangzhou. The analysis shows that they have developed particular abilities to integrate, build and reconfigure internal and external resources to develop and successfully commercialize new products and services (Chapter 3).

The chapter proceeds as follows. The next section provides a summary of the literature. The third section presents the empirical findings for the full data set, showing the antecedent of innovative capabilities and how they add up to five specific innovative capabilities. The subsequent sections then deal with each of these five innovative capabilities in more detail. The chapter concludes with a discussion.

9.2 Innovative capabilities and their antecedents: overview of the argument

9.2.1 Development of innovative capabilities

The development of innovative capabilities depends on the resource base directly or indirectly accessible, the nature of the innovative activity pursued and the local institutional arrangements. The literature on (dynamic) capabilities emphasizes valuable resources as factors explaining firm behavior and performance, stressing the (dynamic) capability to innovate (Teece, Pisano and Shuen, 1997) and to learn (Fiol and Lyles, 1984). Innovative capabilities are firm-specific processes that manipulate the resource base of a firm (Amit and Schoemaker, 1993; Teece et al, 1997).

[44] The preliminary findings presented in this chapter are published in: Greeven, M.J., Zhao, X. (2008) "Innovation, competences and the role of knowledge networks in Hangzhou's software industry", in P. H. M. Vervest, D. W. van Liere and L. Zheng (eds.), ***The Network Experience***, Berlin. Germany: Springer, Chapter 13, pp. 193-211. An extended version is conditionally accepted in: Greeven, M.J., Zhao, X. (2009) "Developing innovative competences in an emerging business system: New private enterprises in Hangzhou's software industry", ***Management and Organization Review (Special Issue on Creativity, Innovation and Entrepreneurship in China)***

The sectoral approaches to innovation show that sectors with distinct technologies can be differentiated according to their specific technical and market risks, or *technological regimes* (e.g. Malerba, Breschi and Orsenigo, 2000; Malerba and Orsenigo, 1993; Dosi, 1988 Parker & Tamaschke, 2005). These characteristics of technological regimes and its knowledge base provide restrictions on firms' learning, capabilities and organization and coordination of innovative activities. This thesis considers three distinct software sectors representative for three types of innovation. Chapter 2 has discussed these issues for the three software sectors under investigation, while Chapters 7 and 8 have shown the variety of innovation patterns and technical and market constraints on innovation.

Comparative institutional approaches to innovation explain how institutions govern the development of organizational capabilities. Institutions guide and constrain the coordination of various economic actors and the way they solve economic problems in terms of the nature of ownership relations, inter-firm connections and governing access to critical resources such as labour and capital (Hollingsworth and Boyer, 1997; Whitley, 1999). As argued in Chapter 3, institutional regimes have distinct patterns of resource provision and distribution and they specify how firms have differential access to critical resources. This results in different firm behaviour and crucially affects competitive strategies and the development of unique capabilities.

Institutional regimes in China's economy have two distinct features: institutional uncertainty and variety of local institutional systems. First of all, China's institutions originate both from the socialist era and market-oriented institutions, which presently co-exist (Krug and Polos, 2004). Firms face underinvestment in resources and have considerable uncertainty regarding what actor is providing what kinds of constraints on the use of resources. Second, the heterogeneity of China's local business environment makes resources location-specific. So, in contrast to most comparative institutional studies, which take the nation state as the boundaries of a unitary business system, China's economy is characterised by a *diversity* of business systems at the sub-national level asking for a local perspective. Chapter 6 provided a detailed study of Hangzhou's local institutional regime and identified key features of the institutional regime in which private software entrepreneurs innovate. Chapter 8 discussed what kinds of institutional constraints these entrepreneurs have to deal with. This sets the frame for understanding the underlying mechanisms of innovative behaviour. Then, how do innovative capabilities come about?

9.2.2 Antecedents of innovative capabilities

Antecedents to innovative capabilities are those organizational processes that provide resources (originating in individual, firm or network) to the firm that can give a potential competitive advantage in successfully developing and commercializing new

products and services. However, these antecedents do not always add up to innovative capabilities. Antecedents add up to a capability only if they alter the firm's resource base to such extent that they generate organization-specific, value-creating strategies for innovation (cf. Chapter 3). Specifically, these antecedents should combine and deploy resources to generate value and should be able to span and support multiple lines of business of the firm, i.e. organization-specific. Antecedents to a specific capability are then all aspects of the same capability but refer to different organizational processes that together generate organization-specific abilities of the firm to integrate, build and reconfigure internal and external resources to successfully develop and commercialize new products and services (i.e. an innovative capability).

To understand how capabilities come about it is crucial to know what their antecedents are. In this chapter we will identify antecedents and on the basis of those antecedents we will single out the innovative capabilities that firms developed. We will investigate the development of innovative capabilities while considering institutional - and sectoral constraints. The former is taken into account by studying innovative capabilities in Hangzhou's local business environment; the latter is taken into account to presenting a comparative study of innovative capabilities across three distinct software sectors. A note on the research method is warranted.

9.3 Empirical findings

9.3.1 Summary of the research method

The substantive purpose of the empirical analysis is to identify innovative capabilities by singling out antecedents to innovative capabilities. The analysis followed inductive qualitative techniques in order to single out those organizational processes that provide resources to the firm that can give a potential competitive advantage in successfully developing and commercializing new products and services. The analysis involved a confrontation of our working theory and the extant literature on innovative capabilities and their antecedents with the empirical data (cf. Uzzi, 1997; Krug & Hendrischke, 2008; Maeki, 1993). This involved the creation of a cross-sector display that indicates the antecedents that were unambiguously named by our respondents, similar to Uzzi (1997). An antecedent was recorded on the list if it was mentioned by more than one respondent. In total 26 different, unique antecedents are mentioned more than one time and in total 160 antecedents were mentioned.

A more formal analysis of the data analysed the distribution and frequency of antecedents mentioned by each respondent. The results indicate that per standard software – and middleware firm, on average, 5 antecedents were singled out whereas per enterprise software firm 6 antecedents. The analysis allows checking for the distribution of features mentioned per firm and the results indicate that there is no evidence for single respondents to mentioning disproportionately many antecedents.

Furthermore, to facilitate the analysis and create an unambiguous understanding of these antecedents we assigned weights to each of the antecedents by calculating the relative importance of each antecedent by dividing the number of times that a specific antecedent was mentioned by the total number of antecedents mentioned. For example, of the total 160 antecedents mentioned by respondents, 6 times 'government subsidies' was mentioned (by 6 different respondents). So, government subsidy has a relative importance of 4% (6/160) in the total data set. We calculated the relative importance of the antecedents for both the total data set and for each sector separately. The subsequent analysis rests on the 26 unique antecedents and their relative importance. The antecedents mentioned only once are put in one category 'all others'. The totals of the columns in **Table 9.2** (p. 167) add up to 100%.

The last phase involved the identification of patterns in the data; i.e. in the list of antecedents to single out innovative capabilities. Qualitative inductive techniques were used to identify capabilities from the listed antecedents by focusing on those antecedents that combined alter the firm's resource base to such extent that they generate organization-specific, value-creating strategies for innovation (chapter 3). Following Uzzi (1997) we did a finer analysis of these antecedents and identified five innovative capabilities; i.e. five constructs. The fit between these constructs involved the grouping of observations – antecedents – based on a set of attributes, i.e. 'fit as gestalt' (Venkatraman, 1989). An exploratory perspective – inductive theorizing – is necessarily less precise in specifying the functional form of fit, as argued by Venkatraman (1989). Similar to the inductive studies of Uzzi (1997) and Hendrischke & Krug (2008) and advocated by Maeki (1993) and Whitley (2007), the confrontation of the constructs with the theory is more useful than using formal statistical methods that reduce data to single isolated observations.

9.3.2 Findings: antecedents and innovative capabilities in three software sectors

Table 9.2 (next page) presents the importance of each antecedent and how they form the basis for a capability. The findings show that the importance of antecedents varies across the sectors. Firms in the standard software sector have the most varied set of antecedents. For instance, in-house training, communication with external experts, organizational reputation and first-to-market strategy. Middleware firms have a more external orientation. It is the firm's reputation in business community, first-to-market strategy, CEO personal network for sharing business information and founder experience that allows these firms to innovative. Enterprise software firms have an internal focus, combining on-the-job training, cooperation with customers for developing new ideas and commercializing university research.

Table 9.2: Antecedents and innovative capabilities of Chinese private software firms

	Standard software	Middleware	Enterprise software	*Total (100%)*
Financial commitment				
private investment	9%	5%	6%	*6%*
government subsidies	6%	2%	6%	*4%*
venture capital investment	6%	2%		*2%*
founder financial capital		3%		*2%*
Total	*21%*	*12%*	*12%*	*14%*
Organizational integration				
in-house training	3%	5%	12%	*8%*
firm-specific technical expertise			3%	*1%*
cross-functional expertise	3%		3%	*2%*
committed employees		3%	1%	*2%*
standardized work routines			3%	*1%*
Total	*6%*	*9%*	*22%*	*14%*
External knowledge transformation				
founder personal contacts sharing business information		14%		*5%*
coordination within the local industry			7%	*3%*
cooperation with customers	9%		13%	*8%*
commercialization of university research			13%	*6%*
coordination of technologies with firms	9%	7%		*4%*
attracting new employees	9%		6%	*4%*
research cooperation with university	9%	3%		*3%*
experts outside the firm	3%	3%	1%	*3%*
Total	*39%*	*28%*	*41%*	*36%*
Reputation development				
standing in the local business community	9%	10%	7%	*9%*
reputation for strong technology	6%	2%	1%	*3%*
founder's entrepreneurial experience		9%	3%	*4%*
membership of industry association	3%	2%		*1%*
Total	*18%*	*22%*	*12%*	*17%*
Strategic flexibility				
first-to-market advantage	6%	12%	1%	*6%*
adaptation to local business opportunities	3%	7%		*3%*
imitation of foreign technology		5%		*2%*
benchmarking other firms' operations			4%	*2%*
acquisition of other firm for technology		3%	1%	*2%*
Total	*9%*	*24%*	*5%*	*15%*
All others	*7%*	*5%*	*8%*	*4%*

These antecedents of innovative activities provide the basis for understanding what kinds of capabilities are developed. Antecedents to innovative capabilities are those organizational processes that provide resources to the firm that can give a potential competitive advantage in successfully developing and commercializing new products and services. Antecedents are organizational processes that form the basis for innovative capabilities if they combine and deploy resources to generate value-creating strategies *and* are able to span and support multiple lines of business.

Finer analysis show that we can single out five innovative capabilities: financial commitment, strategic flexibility, external knowledge transformation, reputation development and organizational integration. *Financial commitment* refers to the ability of a firm to commit internal and/or external sources of financial capital for a long-term investment to assure collective learning for innovation. *Strategic flexibility* refers to the ability that allows firms to change strategic directions quickly to adapt to economic and institutional changes. *External knowledge transformation* refers to the ability that allows the firm to develop, acquire, transform and share knowledge across firm boundaries. *Reputation development* refers to the ability that enables firms to pursue innovative goals by developing and employing 'reputational assets' in the market. *Organizational integration* refers to the ability to commit employees to the firm and contribute their resources to engage in firm-specific learning.

It is worth stressing the significant role of external knowledge transformation (36%) as opposed to the other four capabilities (14-17%). This capability is important across the three sectors, whereas the other capabilities vary considerably in importance. For instance, the findings suggest that organizational integration is particularly important for enterprise software firms (22%) but significantly less so for standard software (6%) and middleware (9%) firms. Strategic flexibility on the other hand appears important for middleware firms (24%) but not so much for either standard software (9%) or enterprise software (5%) firms. Reputation development is most important for middleware (22%) and standard software (18%) firms. The findings show that financial commitment is important across sectors and most important for standard software firms (21% compared to 12%).

It is noteworthy that all five capabilities are important in all three sectors, even though the extent of important differs. In specific sectors specific capabilities dominate. Standard software firms appear to need financial commitment and external knowledge transformation capabilities; middleware firms need external knowledge transformation, reputation development and strategic flexibility capabilities; and enterprise software firms need organizational integration and external knowledge transformation capabilities. Before discussing each of the five innovative capabilities in more detail, it is useful to analyse the antecedents that were mentioned only once.

9.3.3 Findings: 'all others'

In total 37 unique antecedents were identified but 11 were only mentioned by one time ('all others' in table 9.2). Those eleven are excluded from the subsequent analysis. A closer look at these 11 antecedents suggests that they are random. The 11 antecedents range from topics related to strategy and external partners to work organization. **Table 9.3** presents the eleven antecedents that were mentioned only by one entrepreneur. However, when we look at what type of software entrepreneur mentioned the antecedents, a pattern emerges. The enterprise software entrepreneurs appear to show the most uncertainty when it comes to identifying factors for successful innovation, as 7 of the 11 antecedents were mentioned by them. This evidence suggests that middleware and standard software entrepreneurs have a better understanding of what makes them successful innovators. The uncertainty of entrepreneurs notwithstanding, five capabilities stand out and deserve empirical scrutiny.

Table 9.3 - Antecedent mentioned only once by Hangzhou software entrepreneurs

Antecedent	Sector
Acquisition of customer base	Middleware
Personal partners for political information	Middleware
Risk diversification strategy	Middleware
Personal relation government	Standard software
Employees' foreign experience	Enterprise software
Stock listing	Enterprise software
Flexible work organization	Enterprise software
Imitation of domestic firm	Enterprise software
Standardized software platform	Enterprise software
Timing market entry	Enterprise software
Work routines	Enterprise software

9.4 Five innovative capabilities: empirical results

9.4.1 Financial commitment

Financial commitment enables Chinese firms to fight off government controlled sources of finance. It is the ability of a firm to commit internal and/or external sources of financial capital for a long-term investment as to assure the collective learning necessary for innovation. The patterns in the data indicate the crucial role of diverse financial sources in different types of innovative ventures. Four antecedents - private investment, government subsidies, venture capital investment, founder financial capital - provide firms with financial resources that give a potential competitive advantage in successfully developing and commercializing new products and services. These antecedents matter in different degrees across the sector, as the frequency of mentioning by the entrepreneurs indicates (section 9.3.1). For instance, whereas

enterprise software firms tend to have private investment and government subsidies, venture capital and founder's initial capital are more important for middleware firms.

These four antecedents form the basis for an innovative capability as they reflect organizational processes that combine and deploy financial resources internal and external to the firm that allow committed investments in developing and commercializing new product and services. In other words, these four organizational processes are antecedents to the innovative capability 'financial commitment', i.e. the ability to commit internal and external resources to the development goals of the firm. Similar to the different extent of importance of the antecedents across the sectors, this capability matters to different degrees across the sectors. In total 14% of all antecedents are related to financial commitment; but especially important for standard software sector: 21% of all antecedents mentioned in that sector, compared to 12% in both other sectors. Unsurprisingly the standard software sector, characterised by radical, stand-alone innovations are in most need of capital. Enterprise software firms need fewer investments and can often draw on resources from the customer; whereas middleware firms have limited capital needs altogether.

Attracting capital becomes a firm specific capability because firms are small and require capital to grow. However, capital is not (yet) available on a capital market basis, as my findings in Chapter 6 suggest. Therefore, it is an important capability for these firms to be able to access capital. It is useful to distinguish two aspects of financial commitment: source and use. As discussed in Chapter 8, the main sources of finance are still government – and private capital. Enterprise software firms receive the most government support in terms of subsidies and innovation funds. These firms, as shown in Chapter 8, pursue less radical innovations and carry fewer risks of technologies chosen. Moreover, the stable business relations with customers minimize the market risk. Therefore, it is not surprising that most government support will go to these relatively stable firms. The more risky type of investments – such as VC and founder capital – is found in middleware firms. These firms are willing to invest in risky ventures with higher risks of technologies and markets.

The availability of government funding depends on local government policies. In the current policy framework, innovation and software business have high priority (Chapter 6), which makes these government funds relatively attractive and stable. However, there is a real risk of changing policies, as the interviews suggest. The venture capital investments and personal investments depend on the availability of the firm's own resources and/or personal networks that can mobilise financial resources. These kinds of finance are generally more volatile and require frequent 'relationship' maintenance, as suggested by the interviews. Summarizing, access to committed financial capital is a key capability. Access to government and personal capital sources is sought instead of capital market based finance.

9.4.2 Organizational integration

Organizational integration in the Chinese context is a response to very specific human resource management problems: retaining and motivating employees. It is the ability to commit employees to the firm and contribute their resources to engage in firm-specific learning. Firm-specific learning is collective and tacit on the basis of mutual interplay between partners. In this study, the organizational integration capability refers to collective coordination and learning. Five antecedents - in-house training, firm-specific technical expertise, cross-functional expertise, committed employees and standardized work routines - provide firms with skills, competences and committed employees that give a potential competitive advantage in successfully developing and commercializing new products and services. These antecedents matter in different degrees across the sector, as the frequency of mentioning by the entrepreneurs indicates (section 9.3.1). Whereas in-house training is crucial for most of the software firms, it is more important for enterprise software firms (12% versus 3% in standard software and 5% in middleware). Furthermore, enterprise software firms have a variety of organizational processes that relate to developing committed human resources, such as cross-functional expertise development and standardized work routines. The interviews suggest that standard software firms tend to focus more on developing expertise via training and cross-functional competences. Furthermore, middleware firms use training and committed employees to create a strong 'social' organizational culture.

These five antecedents form the basis for an innovative capability as they reflect organizational processes that combine and deploy human resources to the firm that commit employees to developing and commercializing new product and services. In other words, these five organizational processes are antecedents to the innovative capability 'organizational integration', i.e. the ability to commit employees to the firm and contribute their resources to engage in firm-specific learning. Similar to the different extent of importance of the antecedents across the sectors, this capability matters to different degrees across the sectors. Over 14% of all antecedents are related to organizational integration. However they are especially important for the enterprise software sector (22%), compared to the standard (6%) – and middleware sector (9%).

This capability is particularly important for developing incremental, systemic innovations, such as in the enterprise software sector. Considerable knowledge about the whole system is required before a part of the system can be innovated (chapters 2 and 8). To that end a variety of knowledge, reflected in the employees, needs to be integrated and coordinated. Moreover, since enterprise software commonly is customer specific and customized, employees need to invest in accumulating firm-specific skills. The more risky innovative standard software and middleware sectors appear to have less need for organizational integration. Innovation depends on variety

of knowledge sources which is facilitated by flexible and fluid human resource systems. Organizational integration then refers more to coordinating knowledge and skills of the employees with the firm-specific skills.

The importance of organizational integration as a capability for innovation directly flows from the need for internalizing external knowledge, as is the case in radical innovations, and/or collectivizing individual personal knowledge sources, as is the case in incremental, systemic innovations. In short, organizational integration as an innovative capability mostly functions as a *coordination mechanism*. For the more risky ventures this capability is necessary to absorb new technical and business knowledge, or refers to what Cohen and Levinthal (1990) named 'absorptive capacity'. For the less risky, incrementally innovative ventures it is necessary to socialize and commit employees to invest in collective knowledge and learning. Summarizing, organizational integration is a firm-specific capability that focuses on coordination individual – firm-specific skills.

9.4.3 External knowledge transformation

External knowledge transformation refers to the ability to import knowledge that is neither available in-house nor learned in the formal education system. It is the ability to develop, acquire, transform and share knowledge across firm boundaries. Eight antecedents - founder personal contacts sharing business information, coordination within the local industry, cooperation with customers, commercialization of university research, coordination of technologies with firms, attracting new employees, research cooperation with university, experts outside the firm - provide firms with technical and business knowledge resources that give a potential competitive advantage in successfully developing and commercializing new products and services. These antecedents matter in different degrees across the sector, as the frequency of mentioning by the entrepreneurs indicates (section 9.3.1). Some organizational processes are found exclusively in one sector, such as the role of personal contacts of the founder in providing business opportunity information for middleware firms (14% of middleware firms) and commercialization of university research in the enterprise software sector (13% of enterprise software firms). The interviews suggest that standard software firms have the most diverse set of organizational processes that mobilize knowledge resources across firm boundaries: cooperation with customers, commercialization of university research, coordination of technologies with firms, attracting new employees, research cooperation with university and hiring experts.

These eight antecedents form the basis for an innovative capability as they reflect organizational processes that combine and deploy knowledge resources external to the firm that bring knowledge resources to the firm that are necessary for developing and commercializing new product and services. In other words, these eight organizational

processes are antecedents to the innovative capability 'external knowledge transformation', i.e. the ability to to develop, acquire, transform and share knowledge across firm boundaries. In total 36% of all antecedents are related to external knowledge transformation, making it the most crucial capability. These results are not surprising and follow other research on Chinese ventures (e.g. Krug, 2004; Peng and Luo, 2000; Tsang, 1996; Wang, Lo and Yang, 2004; Van de Ven, 2004). However, what is surprising is that the government as an actor is 'left out'. It appears that networking for knowledge follows 'Western' style networking in the sense that it is about technical and business knowledge. This is seen by the interviewees as a big advantage of this sector. Not only firms and sectors are emerging, also markets and government policy is emerging. There is not much experience from the political side, which translates into a lack of a bureaucracy that monitors and controls the sectors. On the other hand it is also clearly a response to limitations in factors markets, e.g. liability of newness (Krug and Polos, 2004). Chapter 6 and 8 have shown the status of the limited availability of the resources financial and human capital.

The findings suggest that this capability is crucial for all sectors but there are considerable differences in the *type of knowledge* (content), *governance* mode (mobilization / coordination) and level of *formality*. With respect to content, access to external knowledge can refer to both business knowledge (8%) and technological knowledge (28%). In the case of *business knowledge (8%)*, this capability refers to the use of the personal network of the CEO to share business information. Business information here refers mostly to information about new opportunities, market knowledge and sharing of solutions to managerial problems. This capability allows *coordination of resources* – knowledge – and this is done in an informal way. Furthermore, it also refers to the coordination of work – customer projects – between local firms within the industry. This form of giving projects and recommendations of customers to other firms in the industry is also an informal way of resource sharing.

Access to technological knowledge (28%) is another activity that this capability allows for. There is a variety of activities: cooperation with customers for developing new ideas, coordination of technological development within the industry, commercialization of university research, recruitment of new talents, research cooperation with university to develop new technologies and communication and collaboration with external experts. The first two activities refer to *coordination* of resources, be it via informal or formal collaborations (20% of network antecedents). The latter four activities refer to the *mobilization* of resources, mostly in more formal ways (16% of network antecedents).

These different activities, in terms of governance, content and formality of sharing of resources, are used for different innovative activities. My findings suggest that standard software development – radical, stand-alone innovation – requires a

balanced use of variety of external sources, related to technical knowledge development and governed in both formal and informal ways. Middleware development – radical, modular innovation – on the other hand requires those activities that result in sharing of business knowledge, which is in line with the strategic flexibility capability that allows these firms to search for the right business model. Governance of such network assets is predominantly informal. Enterprise software development – incremental, systemic innovation – focuses on activities that enhance cooperation with customers, commercialization of university research and accumulation of technical knowledge. Governance of the cooperation is usually formalized in contracts as the projects are usually large and tightly connects the customer and the software firm in the software development process.

It's worth noting that enterprise software firms rely on formal networks, which are less flexible, more rigid but also more stable. Such stability would be an advantage in a stable institutional setting, but in this dynamic setting is likely to be a burden for learning and development, something that both standard software and middleware firms can do. One positive point is that enterprise firms, as do standard software firms, focus on building up technical knowledge, which could give them a competitive advantage in terms of technologies. Summarizing, external knowledge transformation enables firms to coordinate and mobilize external business – and technical knowledge.

9.4.4 Reputation development

Reputation here refers to personal reputation as opposed to organizational reputation. It is the ability that enables firms to pursue innovative goals by developing and subsequently employing 'reputational assets' in the market, i.e. creating visibility and credibility as a successful innovator. A firm's reputation often summarizes a lot of information and shapes the ideas of customers, suppliers, partners and competitors. Four antecedents - standing in the local business community, reputation for strong technology, founder's entrepreneurial experience, membership of industry association - provide firms with reputational resources that give a potential competitive advantage in successfully developing and commercializing new products and services. These antecedents matter in different degrees across the sector, as the frequency of mentioning by the entrepreneurs indicates (section 9.3.1). Whereas standing in the local business community is crucial across all sectors, a reputation for strong technological competences is more important for standard software firms (6% versus 2% in middleware and 1% in enterprise software) and the founder's personal reputation matters most for middleware firms (9% versus 3% in enterprise software.

These four antecedents form the basis for an innovative capability as they reflect organizational processes that combine and deploy reputation resources that increase visibility and credibility in developing and commercializing new product and services.

In other words, these four organizational processes are antecedents to the innovative capability 'reputation development', i.e. ability that enables firms to pursue innovative goals by developing and subsequently employing 'reputational assets' in the market. Similar to the different extent of importance of the antecedents across the sectors, this capability matters to different degrees across the sectors. In total 17% of all antecedents are related to reputation, but it is more important for middleware firms (22%) and standard software firms (18%) than for enterprise software (12%). Standing in the business - or technical community and having 'reputational assets' enables firms to achieve various goals, such as innovation, in the market, by identification of the value of the firm's previous efforts by external constituencies and via accumulated human – and social capital in career histories. A founder's entrepreneurial experience plays a role in radically innovative ventures, such as in the middleware sector, than in moderately risky ventures, such as the enterprise software sector. In the latter, the collective reputation of the firm is more important.

The findings suggest that the firms get their reputation from individuals, either founder or employees, not from active reputation building activities, such as advertisements. This capability is strongly related to the other capabilities, as it for instance, enhances the chances to get access to (government and personal) finance and increases the likelihood of being a desired business partner. Moreover, it is a way to overcome liabilities of newness because it is easier to convince customers and suppliers / business partners of the enterprise's innovative abilities. Having a reputation for being innovative thus reinforces the other innovative capabilities. Summarizing, the development of reputation based on individual or collective status is a key capability for innovation.

9.4.5 Strategic flexibility

Strategic flexibility refers to a long-term capability to secure a sustainable position in an environment of uncertainty. It is the ability to change strategic directions quickly to adapt to changing economic and institutional conditions. The key point is here that firms keep their options open given widespread uncertainty. This uncertainty arises from an emerging, unpredictable market, changing government regulations and general lack of business experience, organizational 'blueprints' and collective memories in the business environment. The fact that these firms can keep their options open is a result of their relative freedom in Hangzhou which provides enough opportunities while the restrictions are not constraining, as shown in Chapter 8.

Five antecedents - first-to-market advantage, adaptation to local business opportunities, imitation of foreign technology, benchmarking other firms' operations, acquisition of other firm for technology - provide firms with a flexibility of resources usage that gives a potential competitive advantage in successfully developing and

commercializing new products and services. These antecedents matter in different degrees across the sector, as the frequency of mentioning by the entrepreneurs indicates (section 9.3.1). Some organizational processes are found exclusively in one sector, such as imitation of foreign technology by middleware firms (5% of middleware firms) and benchmarking the operations of other local firms by enterprise software firms (4% of enterprise software firms). First-to-market advantages are found across all sectors but mostly in the middleware sector.

These five antecedents form the basis for an innovative capability as they reflect organizational processes that quickly combine and deploy a variety of resources internal and external to the firm that allow flexibility in developing and commercializing new product and services. In other words, these five organizational processes are antecedents to the innovative capability 'strategic flexibility', i.e. the ability to change strategic directions quickly to adapt to changing economic and institutional conditions. Similar to the different extent of importance of the antecedents across the sectors, this capability matters to different degrees across the sectors. In total 15% of all antecedents are related to strategic flexibility, but especially important for middleware firms (24%) as compared to standard (9%) and enterprise software (5%). The patterns in our data show how business models reflect different strategic orientations for different technical fields or market considerations. Especially middleware firms appear to be flexible in their strategic choices, aiming to capture a part of the market as quickly as possible and learn skills from every source possible. Firms try to establish themselves in market niches and develop a core technology. Enterprise firms, on the other hand, focus mostly on learning from local customers and are flexible to the extent that they want to meet (changing) customer requirements. Standard software firms pursue flexible strategies that allow them to 'jump' into opportunities and the firms in our sample behave rather opportunistically. Both the behaviour of enterprise software and standard software firms reflect short-term goals. Strategic flexibility enables firms to respond to opportunities in an emerging market.

These results are not surprising: middleware firms are the youngest, least experienced and most volatile firms in the three sectors. This sector did not develop really and the firms are still searching for the right way of doing business. The interviews suggest that there are high rates of founding and failure, even though we cannot confirm this with official statistics. Moreover, the key challenge for most middleware firms is to define their core business model. Furthermore, previous research on Chinese ventures suggested that private firms generally behave opportunistically and have a short-term focus. However, the interviews suggest that these firms are experimenting to find the right model and in that sense have a long-term *goal*. To reach that goal, the strategy has to be flexible to quickly establish a customer base and develop and learn complicated new technologies, either via local

industry peers or imitation of foreign examples. Generally, short term flexible – opportunistic - strategies are found in standard – and enterprise software sectors, whereas the middleware firms have long term strategic goal.

9.5 Discussion of the findings

The empirical comparative case study of 45 software entrepreneurs in Hangzhou provides evidence for specific innovative capabilities across three distinct sectors. The findings point at five capabilities as particularly important for innovation: financial commitment, organizational integration, external knowledge transformation, reputation development and strategic flexibility. **Table 9.4** shows the main findings.

Table 9.4 – Findings: Importance of innovative capabilities across software sectors*

	Standard software	Middleware	Enterprise software	*Total*
Organizational integration	6%	9%	**22%**	14%
Financial commitment	**21%**	12%	12%	14%
External knowledge transformation	39%	28%	**41%**	**36%**
Reputation development	18%	**22%**	12%	17%
Strategic flexibility	9%	**24%**	5%	15%

** The percentages per sector do not add up to 100% because the three sectors miss 7%, 5% and 8% respectively. These missing percentages refer to the 'all other' category of antecedents mentioned only once that do not contribute to an innovative capability.*

It is useful to discuss the differences in importance of these capabilities. The percentages indicate relative importance, i.e. how important each competence is compared to the other capabilities. For instance, the findings indicate that external knowledge transformation (36%) is roughly two times more important for firms' innovation potential than the other individual capabilities (on average 15%). In essence this means that the ability of firms – as measured by the antecedents named by the respondents – to transform and use external knowledge is the most crucial competence. However, this competence is necessary but not sufficient, i.e. all five capabilities are needed for firms to innovate as my evidence suggests that all firms across the sectors have all these capabilities. The different levels of importance merely indicate how much effort – for instance in terms of capital investment – was given to the different capabilities for successful innovation.

It is worthwhile to point out that the extent to which these capabilities play a role varies across sectors. The relative importance of the capabilities varies across sectors. For instance, organizational integration is more important (22%) for enterprise software firms than for standard software firms (6%). Again, this indicates that firms in distinct sectors differentiate their efforts accordingly. These differences in level are

directly related to the technical and market characteristics and innovative patterns in the distinct sectors, as discussed in the previous part.

9.5.1 Comparison of findings with literature

Other studies suggest that *financial commitment* plays a role as a complementary resource (Teece, 1986) that enables the firm to profit from core knowledge (next to manufacturing, marketing and sales) or as a functional area resource that is relatively general in nature and can be applied in most markets (Helfat and Lieberman, 2002). Lazonick (2004) distances himself from this position by emphasizing the crucial role of financial commitment, as one of the three 'social conditions of innovative enterprise.' Seeing innovation as a collective and cumulative learning process, he argues that investments in cumulative and collective learning require committed finance (Lazonick and West, 1995). This thesis suggest that financial commitment is neither a 'complementary' nor a 'general resource' but one of the necessary innovative capabilities for entrepreneurs in Hangzhou. In line with Lazonick's argument, Hangzhou software entrepreneurs need the commitment of internal or external sources of financial capital for a long term assurance of collective learning which is necessary for innovation. More generally, it makes sense for these software firms to put financial commitment centre stage in innovation development as they are small and have limited legitimacy in financial markets.

The literature attributes a variety of functions to *organizational integration*. Penrose (1959) already observed that people contribute labour services to their firm as teams who engage in learning about how to use the firm's - and their own resources. Therefore, the willingness of groups of employees to commit themselves to the firm and engage in improving firm-specific knowledge determines to a considerable extent the development of distinct organizational capabilities (Whitley, 2003). The firm can be regarded as a 'competent team' (Eliason, 1990) where managers coordinate and integrate the activities inside the firm. The collective dimension in the theory of the firm can also be found in Kogut and Zander (1992) who argued that firms represent social knowledge of coordination and learning. In general, the literature agrees that organizational integration transforms individual capabilities into collective, firm-specific skills. My results suggest that the crucial aspect of organizational integration is the coordination of employees' individual skills and firm-specific skills, as opposed to the transformation from individual to collective capabilities. This capability is a response to a China-specific constraint, namely how to retain and motivate employees to commit resources to the firm in an environment with high labour turnover, weakly developed labour markets and competence uncertainty.

Prior research on innovation has shown that linkages and collaboration networks are crucial for a firm in order to innovate (Powell, Koput and Smith-Doerr, 1996;

Kogut, 2000). The reliance on external sources of knowledge is often considerable in newly emerging industries. The differences between types of partners, the extent of knowledge sharing and the extent of integration of information from diverse sources, affects how relationships are managed and what types of innovations they generate (Whitley, 2002). Especially the literature on inter-firm collaborations has detailed the various aspects of networks: structure and content (Adler and Kwon, 2002); governance (Grabher, 2004; Nooteboom, 2004); goals and intentions (Hendrischke, 2004); and scope (Grabher, 2004). The findings in my study suggest that for the Chinese case, content, governance and extent of formalization are features that can distinguish different types of networks. Moreover, the findings suggest that networks themselves are not agents of economic activity. On the contrary, the network capability enables a firm to mobilize and transform resources across the firm's boundaries. These inter-firm connections have certain features, such as content, governance, formalization, that influence the governance of resources but by no means become agents. The firm remains the key agent that develops capabilities to reach a certain desirable goal. This capability is a response to China-specific constraints: limitation in factor market, more specifically, asymmetry in knowledge markets.

Prior research has shown that innovative or entrepreneurial prominence of firms can have several antecedents. On the one hand, reputation arises from the identification of the value of the firm's previous efforts by a reputation building activities such as advertising and sponsorships (Fombrun, 1996). In a study of the auto industry Rao (1994) also found that highly visible events such as winning a quality contest improved firms' reputation. Furthermore, reputation is related to the firm's position in the social structure (Podolny and Philips, 1996). My findings confirm that reputation is mostly related to the position of the firm - as a collection of individuals - in the wider business community. It is important to note the difference between reputation of the firm as a collective entity and the reputation of the founder. The importance of this capability makes sense as the firms are small and need to overcome legitimacy problems with suppliers and customers. Noteworthy is the fact that the capability refers to developing and employing reputation whereas the origin of reputation is the founder and employees' position in business communities.

Prior research has shown that firms in an environment with high competence destruction risks need to be able to change direction very quickly and destroy their capabilities in search for the dominant design (McKelvey, 1996). Firms typically innovate radically (Tushman and Anderson, 1986) and develop specialized complementary assets to mitigate the effects of competence destruction (Tripsas, 1997). Teece et al. (1997) consider strategic reorientation as a choice among and commitment to long-term partners for trajectories of cumulative capability development. In contrast, strategic reorientation can also refer to radical strategic

shifts from one technology to another or one market to another, depending on the level of firm's commitment to its employees and external partners, as well as the specialised skills present within technical fields or sectors (Whitley, 2002). In the former, training and customer specific knowledge enhance firm-specific knowledge leading to less radical strategic shifts (Rosenbloom and Christensen, 1998), whereas as in the latter, hiring staff with new skills or acquiring firms with different technical specializations may involve radical changes in the firm's capabilities (Zucker and Darby, 1997).

The empirical findings suggest that strategic flexibility enables entrepreneurs to quickly respond to opportunities while developing a customer base and learning new technologies. This capability is crucial for young and small software firms. The more so because China's business environment creates opportunities that firms need to recognize but also restraints which firms need to overcome (cf. Chapters 2, 6, 8). A key difference with existing literature on strategic flexibility is that it is also about organizational changes, not necessarily technical changes. As discussed in Chapter 7, firms develop both organizational – and/or technical innovations in response to a variety of constraints (Chapter 8).

At first sight strategic flexibility and organizational integration appear to be contradictory. However, enterprises exactly need both capabilities: On the one hand, strategic flexibility allows learning and acquiring new knowledge. On the other hand, given their inexperience, limited resources and lack of legitimation, these enterprises need to develop capabilities to internalize and collectivize this new knowledge and experience. The capability functions as an internal coordination mechanism. Therefore, there is a subtle balance and trade-off between flexibility and stability. Perhaps the best analogy is March's distinction between explorative and exploitative activities. Following Nooteboom's (2004) cycle of exploitation and exploration, enterprises need to search first for new knowledge, then consolidate this and generalize it within the enterprise boundaries to be able to exploit the new knowledge.

9.5.2 Benchmarking the patterns with out-of-sample patterns

It is worthwhile to compare the patterns of innovative capabilities in the sample to out-of-sample examples of successfully innovating firms. The work of Lu (2000) and Lu and Lazonick (2004) on non-governmental computer firms Stone, Lenovo, Founder and Great Wall provides strong evidence for organizational integration and financial commitment as crucial capabilities, but less so for external knowledge transformation for successful innovation. This difference is explained by the fact that the key source of knowledge for these non-governmental firms is the state's S&T knowledge base to which they had unlimited access via their special governance mode with a collective/public nature as a result of their origins in the state socialist economy. The reputation benefits, exemplified by the ease with which they secured markets, are

considerable (Lazonick, 2007). Our private firms on the contrary have to focus on external knowledge transformation – the inputs - in the absence of such 'hidden subsidies'. At the same time, the development of reputation to secure new markets – the outputs - then becomes a crucial capability.

It is also useful to compare our results with the successfully innovating Huawei, a privately established network solutions provider. The key capabilities of Huawei are found in the widespread cooperation with key industry players and major universities (cf. external knowledge transformation), their own R&D capacity and a strong organizational commitment (cf. organizational integration) via teamwork culture, bonus and stock options and on the job training (Lau et al., 2002). On a more general level, successful knowledge management, which is at the core of innovation, in large high-tech firms in China is facilitated by social capital and absorptive capacity (Lau et al., 2002). These successful large firms (Huawei, Founder, Lenovo, Stone, Great Wall and others) appear to exemplify the importance of external knowledge transformation, financial commitment and organizational integration. The importance of reputation development and strategic flexibility for the firms in our sample is necessarily related to size and experience. Whereas the large firms built upon their established reputation, smaller entrepreneurial firms need to build reputation and capture a market using strategic flexibility. In sum, benchmarking the pattern of innovative capabilities with out-of-sample examples strengthens the reliability of the findings.

Chapter 10

Summary of findings and discussion

10.1 Innovation in China: sectors, institutions, resources and capabilities

This study started with the observation that Chinese entrepreneurs in IT sectors in coastal regions are not only able to survive but also to innovate in China's transition economy. Businesses in transition economies face increased uncertainty, opportunism and search costs for critical resources and at the same time has reduced incentives for anything more than survival, such as innovation. The main question addressed in this thesis is: what kind of capabilities for innovation did domestic private entrepreneurs develop in China's uncertain transition economy? This thesis suggests that entrepreneurs developed a unique set of innovative capabilities to overcome resource constraints and manage technical and market risks while respecting institutional and sector-specific constraints. More precisely, the main thesis is that Chinese software entrepreneurs were able to transform external knowledge resources and integrate these in the firm while committing investors and employees in order to explore and exploit opportunities driven by new technologies, customers and enterprise's own initiatives.

This thesis centers on analysing how and why innovative capabilities are developed. Chapters 1 and 3 argued that innovative capability development depends on the 1) critical resources directly or indirectly available to the entrepreneur; 2) nature of the innovative activity pursued and 3) institutional arrangements in the business environment. Innovative capability development depends on the critical resources available to the firm while technological conditions affect the requirements of critical resources for innovation and institutional conditions affect the availability of critical resources. More precisely, firms face specific sectoral constraints – competence destruction and appropriability risks – in addition to specific institutional constraints – lack of resources and uncertainty about the governance of resources.

Then, several goals are addressed by this thesis. The study starts with *setting the institutional frame* for innovation by analysing the features of the key institutions that govern and coordinate access and distribution for critical resources for the software sectors. Subsequently, the core of the study proceeds to analyse *underlying firm-level mechanisms* that explain the development of innovative capabilities of Chinese private entrepreneurs in that institutional frame. More specifically, the analysis aims to: (1) identify and explain innovative behaviour of Chinese private firms; (2) identify and analyse sectoral – and institutional constraints on innovation and (3) analyse the development of innovative capabilities in response to those constraints.

This thesis presents a detailed comparative analysis of distinct sectors in Hangzhou: enterprise software, standard software and middleware. These sectors are the three main software sectors in terms of type of software development. Moreover, they are sectors with distinct innovation patterns. This allows us to analyse and understand innovative capability development not only across the most important software sectors but also across different types of innovation. The sample consists of 45 software enterprises in three distinct software sectors. Data were gathered mainly through intensive fieldwork in China. It consists of two long fieldtrips between 2005 and 2007. The thesis relies on two data sets: in-depth interview data of 45 Chinese software ventures and archival data, including company websites and industry news triangulate data. This chapter will present a summary of the findings, contributions and explanatory power of the thesis. The four sub questions presented in the introduction are answered in the four groups of findings in sections 10.2-10.5.

10.2 Findings I: Setting the institutional frame for innovation

How do institutions govern and coordinate access and distribution of critical resources for innovation in the software sectors at the local level (first sub question)? The critical resources for successful innovation of private software entrepreneurs (SMEs) are capital, labour and knowledge (see Chapters 2 and 3). We can usefully distinguish the institutions that govern capital, labour and knowledge as the key institutions for understanding innovative capability development in the software sectors: role of the state, skill development and formal education system, and the financial system (role of private and foreign capital). Before turning to the local level and the features of Hangzhou's institutions, we will present the general institutional conditions in which IT sectors and software sectors in specific have developed in China (Chapter 2).

10.2.1 General institutional frame

The analysis shows that during the past three decades resources were created and mobilized that facilitated the growth of China's IT industries in general and software in particular. Economic considerations play a more significant role than political considerations in increasing private and foreign investments, developing human capital and promoting entrepreneurship. Therefore, we can no longer assume institutional transition to be driven by exogenous factors such as 'the state' or 'foreign capital'. On the contrary, institutions transform as a result of the interplay between endogenous and exogenous factors. These factors at a national aggregate level include a redirection of resources and production from state socialist economic agents to private domestic and foreign enterprises.

First, an increase in foreign investment inflow, a growing – although still very limited – venture capital market and an increase in private savings as a result of

deregulation of foreign and capital policy have boosted investment and competition. Second, upgrade of China's human capital base through a thorough reform of the formal educational system and increased emphasis on on-the-job training in combination with imported foreign expertise. Third, promotion and facilitation of private entrepreneurship, especially in new high-tech industries. In short, China no longer follows a central plan or strong political considerations in distributing and coordinating access to resources but a combination of economic and political considerations. China's state-controlled reform agenda involved decentralization of decision making power and resources to local business communities and -governments. The consequences of such transformation cannot be assumed to be similar across China. What are the findings for Hangzhou's institutional environment?

Proposition 1: China no longer follows a politically determined plan for distributing and coordinating resources. Instead, economic development reflects a combination of economic and political considerations.

10.2.2 Hangzhou's institutional environment

The findings in Chapter 6 show that Hangzhou has developed a distinct local business system in China's national economy. First, the local government in Hangzhou plays a 'behind the scenes' role. The dominant conception of the state as a dominant agent in China needs to be modified, since the case of Hangzhou suggests that the state allows market forces to shape local economic development. The only significant exception is the establishment of technology zones which function as institutional mechanisms to facilitate the development of high-tech industries for instance via tax reductions and provision of telecommunications infrastructure. Following a policy of laissez-faire, the local business community dominated by private entrepreneurs flourishes.

Second, the findings with respect to skill development in Hangzhou show that there are elite universities, good monetary incentives for IT jobs and increased professional skills training organized by companies. Zhejiang University belongs to the top universities in China and provides the local business environment with a large pool of talented employees. Therefore, relatively strong and rich local labour resources facilitate human resource development in firms. However, there's low geographic mobility and high workplace mobility that makes it difficult for employers to commit employees to their firm. There is a general scarcity in competences and a weak labor market that is inefficient in connecting firms and (potential) employees. A lack of coordination via agencies or the local government and the prevalence of informal agreements and networks make the labour market ineffective. In fact, the labour market is *de facto* deregulated, competitive and fluid within the borders of Zhejiang province.

Third, the financial system is highly biased towards private capital and foreign investments. Increased private savings and (foreign) investments in tertiary industries provide opportunities while at the same time creating strong competition for private - and foreign capital. A low availability of bank loans and ineffective venture capital markets limit the efficiency of allocation of capital via the formal financial market. Whereas the formal financial markets are highly regulated in Hangzhou, the informal markets are not transparent and lack regulations that formally coordinate transactions.

It is striking to find a local business system within the one-party state of China that is characterised by high market competition, a non-intervening local government and a focus on innovation and entrepreneurship. Using common definitions of capitalism and market economy, Hangzhou's business environment would meet most of the criteria. Private firms are the dominant form of ownership and the service-oriented tertiary industries are flourishing as opposed to traditional industries. These 'market-like' characteristics are even more evident in the high workplace mobility of employees, strong monetary incentives for high-tech jobs, the presence of an elite university and domestic and foreign R&D institutes. This 'system' is operating without bank loans and stock listings, a labour markets resting on informal networks, high labour turnover and uncertainty with respect to the capabilities of employees.

These features of Hangzhou's local business environment are not new, we find strong evidence for path dependency at the local level. First, the role of the local government has historically been behind the scenes due to a large extent of local autonomy and a strong local business community. Next, private capital and entrepreneurship have played a significant role, even during the high-times of communism. Next, Hangzhou's local economy has been integrated in global markets via overseas entrepreneurs, less due to its natural position.

Proposition 2: Hangzhou's business environment, despite being part of the one-party state of China, is characterised by intense competition, non-intervening local government and focus on innovation and entrepreneurship, indicating a capitalist business environment.

Proposition 3: The development of Hangzhou's business environment shows path dependency at the local government level.

10.3 Findings II: Innovation in three Chinese software sectors

What kind of innovative behavior do Chinese software entrepreneurs show (sub question 2)? One of the most significant findings is that Chinese software entrepreneurs *are* innovative. The findings show that Chinese entrepreneurs do not

only innovate incrementally, making small modifications, but also develop radical innovations. Moreover, radical innovation is found both in stand-alone settings and within modular systems. This suggests that innovation in Hangzhou is not limited to certain types of innovation but shows strong variety, even within one industry. We also identified distinct innovations patterns: Innovation in the enterprise software sector is customer-driven product innovation. Innovation in the standard software is technology-driven product innovation. It is noteworthy that product innovations in the enterprise software sector were exclusively customer-driven; suggesting that the same type of innovation can have a different drivers. Innovation in the middleware sector is mostly enterprise-driven business model innovation. Business model innovations in this sector are driven by enterprise, in-house initiatives, cf. standard software firms.

The Chinese software entrepreneurs remind us of 3 things. First, innovation is not necessarily technical innovation. These entrepreneurs do not limit innovation to technical innovation but also include organizational innovation. About half of the innovations are in market and business model as opposed to exclusively innovating processes or products. Second, innovation is not restricted to environments with a strong protection of intellectual property rights (IPR). Organizational innovation or the interplay between technical and organizational innovation provide alternatives to secure appropriability. Third, the emerging nature of Hangzhou's software market gives leeway for experimentation. The data supports this claim as almost half of the drivers for innovation are novel ideas from the firms as opposed to responses or changes in technologies or customer demands. Moreover, many innovations are responses to incentives set by institutional factors such as information asymmetry in the market and deregulation of financial markets. Hangzhou appears to provide incentives for creative behaviour of firms.

Proposition 4: Chinese entrepreneurship reveals a type of innovation that is not only technical innovation, but also includes organizational innovation.

Proposition 5: Successful innovation is not restricted to environments with a strong protection of intellectual property rights.

As will be shown in what follows, Hangzhou's business environment provides a breeding ground for creativity, innovation and entrepreneurship and facilitates the development of innovative capabilities.

10.4 Findings III: Sectoral and institutional constraints on innovation

What kind of sectoral and institutional constraints influence the development of innovative capabilities by Chinese software entrepreneurs (sub question 3)? As

discussed in Chapter 2, the literature on technological regimes and innovation systems shows that sector with distinct technologies carry specific technical and market risks. In Chapter 8 I distinguished two types of risks that are related to the technical and market characteristics of innovative activities: appropriability risk and competence destruction. The data in my sample confirm that different sectors carry distinct risks. It is useful to summarize the main sectoral constraints for the software entrepreneurs.

Entrepreneurs in the enterprise software sector face low competence destruction risks because there are high levels of customization of products. Moreover, enterprise software firms follow foreign trends and technologies that have been proven to be useful and successful for certain software developments. However, the sector has high appropriability risks due to intense competition but also due to weak IPRs and mostly local domestic competition. Entrepreneurs in the standard software sector face high competence destruction risks due to technical uncertainty but also due to unfamiliarity with market requirements. Firms have low appropriability risks because of the technical complexity of their products but are also limitedly constrained by weak IPRs. Entrepreneurs in the middleware sector face high competence destruction risks as a result of uncertainty about standard setting by the government. Middleware firms have low appropriability risks due to complex technology but also face limited constrains from weak IPRs. They innovate radically in business model, while often employing simple, existing technologies (usually developed in the US).

To what extent does the institutional environment play a role in the development of innovation across sectors? In Chapters 3 and 7 we argued that private entrepreneurs have to compensate the underinvestment in labour, capital and knowledge resources in Hangzhou while fighting off the uncertainty of the governance of the existing resources. In this study we presented a detailed firm-level analysis of the effects of these institutional constraints for entrepreneurs. The findings show that constraints caused by underinvestment in resources and the uncertainty of their governance for private entrepreneurs are different across software sectors in Hangzhou. It is useful to summarize the main institutional constraints across sectors.

Entrepreneurs in the enterprise software sector face high institutional uncertainty because a) they are affected by changing local policies, b) have a political risk as many customers are government departments and agencies and c) current foreign policy facilitates foreign enterprise software firms at the cost of local firms. Moreover, these firms are considerably constrained in their use of labour and knowledge resources: they face scarcity of skilled employees, competence uncertainty and a lack of market knowledge. Next to that, firms face coordination uncertainty; i.e. considerable asymmetric information in the market, where government agencies (capital), business (knowledge and labour) and universities (labour, knowledge) all have parts of

information and provide partial access to key resources. Enterprise software firms face low constraints of limited financial capital availability. Firms have generally low requirements for financial resources as technological development carries relatively limited financial risks. Moreover, firms receive considerable support from the local government in terms of subsidies for office, equipment and tax reductions.

Entrepreneurs in the standard software sector are highly constrained in their use of knowledge resources. The firms lack marketing skills, especially, the management and use of brands. The sector in general is too young and dynamic to have built up a collective memory and knowledge of markets, technologies and management necessary for the usually complex technologies of standard software development. Moreover, these firms face considerable constraints with respect to labour and capital resources. The firms have a relatively low legitimacy in labour markets and face a scarcity of technical employees. Furthermore, a lack of legitimacy in financial markets plays a role because new, inexperienced firms have trouble getting investments. Considering the relatively underdeveloped formal financial market (Chapter 6), legitimacy is important to attract private or foreign capital. Lastly, these entrepreneurs also face considerable risks of institutional uncertainty. There is uncertainty about how government agencies will respond to the expected increase in competition from both domestic firms and foreign firms. Furthermore, local preferential policies often are not implemented to their full purpose and in contrast to promoting innovation, they promote homogeneity in products and development processes.

Entrepreneurs in the middleware sector face only limited constraints with respect to the access and use of critical resources. The interviews suggest that labour mobility in the middleware sector is efficiently coordinated via informal – personal – labour markets, as opposed to formal labour markets with labour agencies and standardized capabilities. However, it has to be noted that consistent with the other sectors, there is a scarcity of technical employees. With respect to capital resources, there is a relatively low need of financial capital for middleware development and there's an abundance of personal capital which meets their limited capital requirements. Middleware firms also have limited constraints of underinvestment in knowledge. Firms tend to collectively follow international standards and technical developments. The adaptation of foreign technology with the use of R&D partnerships with universities provides the firms with enough technical resources. The middleware firms seem to draw on collective local knowledge of the local business environment to adapt technologies and commercialize these successfully. With respect to institutional uncertainty, little state interference, newness and incapability of the government apparatus to follow advanced technological changes limit the institutional constraints.

These findings suggest that the constraints for private agents caused by institutional transformation are not similar across sectors. In particular, the underinvestment and governance problems have different consequences for distinct sectors. Institutional constraints appear not only to constrain the development of competence enhancing strategies – such as in the enterprise software sector – but also the development of particular competence destroying strategies – such as in the standard software sector by increasing competence destruction and appropriability risks. However, innovative activities of middleware firms do not appear to be constrained by lack of resources or institutional uncertainty. This suggests that institutional constraints are not always constraints as such. Considering these different effects, we can no longer assume that institutional constraints are similar across sectors because resource and governance requirements differ across sectors. This leads us to reconsider the effects of 'weak' institutions across diverse sectors and localities in China.

Proposition 7: Institutional constraints have different consequences in different sectors.

Proposition 8: Institutional constraints set incentives for the development of innovation and entrepreneurship.

10.5 Findings IV: Capabilities and institutions

10.5.1 Capabilities for innovation in Hangzhou

What kind of innovative capabilities are developed by Chinese software entrepreneurs in response to sectoral and institutional constraints (sub question 4)? The findings show that Chinese private software entrepreneurs have developed five specific innovative capabilities: organizational integration, financial commitment, external knowledge transformation, reputation development and strategic flexibility. Organizational integration refers to the ability to commit employees to the firm and contribute their resources to engage in firm-specific learning. Financial commitment refers to the ability of a firm to commit internal and/or external sources of financial capital for investment as to assure the collective learning necessary for innovation. External knowledge transformation refers to the ability that allows the firm to acquire and transform knowledge across firm boundaries. Reputation development refers to the ability that enables firms to pursue innovative goals by developing and subsequently employing 'reputational assets' in the market. Strategic flexibility refers to the ability that allows firms to change strategic directions quickly to adapt to changing economic and institutional changes. These innovative capabilities reflect firm-specific abilities to integrate, build and transform internal and external resources.

How are these five capabilities related to each other to form distinct configurations? The five capabilities do not represent different components, but form a 'configuration' of capabilities in this particular institutional setting, i.e. all five are necessary for innovation. The connection between the capabilities is that they provide, mobilize, transform and combine critical resources for innovation in response to resource constraints in Hangzhou's business environment. Whereas each capability forms a necessary condition, separately they are not sufficient to assure the successful development and commercialization of new products and services. Therefore, it is the combination of these five capabilities that forms a sufficient and necessary condition for innovation. This thesis directly follows the empirical result that indeed these five capabilities are found across the three sectors in Hangzhou. In other words, the entrepreneurs mentioned these specific organizational processes to be crucial for innovation in their firms. Moreover, the direct link to resource mobilization connects the financial commitment, organizational integration and external knowledge transformation capabilities, while reputation development can be understood as an underlying organizational process that facilitates and supports the development each of these three capabilities. Reputation development is a crucial capability for mobilizing capital, labour and knowledge resources. Each of these capabilities is connected to the strategic flexibility capability because it is the flexible use of capital, labour and knowledge resources that allow the firm to explore innovative opportunities in Hangzhou's business environment. Therefore, without the flexibility of strategic directions, firms cannot exploit their other capabilities to the fullest extent. In sum, each innovative capability reinforces the other while simultaneously depending on the support of the others.

However, different kinds of innovations do require different sets of capabilities. A different set of capabilities here means that even though all capabilities are necessary, the extent to which they are important varies for different kinds of innovations. The comparison across the three software sectors does not only allow us to see capability development in the main sectors of software development but also – as indicated in Chapter 2 – allow us to compare distinct types of innovation in relation to capability development. Specifically, we can compare three types of innovation, represented by the three software sectors, to show that different types of innovation require different configurations of capabilities. The dominant pattern of innovation in the standard software sector is radical product innovation. The findings suggest that this type of innovation required financial commitment, external knowledge transformation and reputation development as the most important capabilities. The dominant pattern of innovation in the middleware sector is radical business model innovation and required external knowledge transformation, reputation development and strategic flexibility as capabilities. The dominant pattern of innovation in the enterprise software sector is

incremental product innovation and required organizational integration and external knowledge transformation as most important capabilities.

Which sectoral conditions determine how important each capability is and which institutional conditions set the range of potential capabilities? The comparison of the three distinct sectors allows us to connect sectoral conditions to capability development. Sectoral conditions determine how important each capability is. We have seen that there are two sectoral conditions that shape innovative capabilities: competence destruction risk and appropriability risk. The first is assessed by uncertainty of market acceptance and uncertainty of investments in technology, while the latter is assessed by the risk of imitation. These conditions provide restrictions on the development of capabilities. In our study we find that in a sector – enterprise software -with low competence destruction risks and high appropriability risks, the role of the organizational integration capability is crucial. In sectors with high competence destruction risks, such as middleware and standard software, the role of financial commitment (in the standard software sector) and the roles of reputation development and strategic flexibility (in the middleware sector) are more important. Interestingly, regardless of distinct sectoral conditions, the external knowledge transformation capability is crucial in all three software sectors. This suggests that this capability is a response to a more important set of conditions, institutional conditions.

Institutional conditions affect the range of potential capabilities. More specifically, the specific institutional constraints – on capital, labour and knowledge resources – in Hangzhou's business environment require a specific set of capabilities. In other words, capabilities need to overcome these institutional constraints. Entrepreneurs in the enterprise software sector relied on committing employees to developing firm-specific capabilities and integrating external knowledge into the firm's boundaries in order to offset the underinvestment of knowledge and labour resources, while mitigating institutional – political – risks by developing a strong reputation in the local business environment. Entrepreneurs in the standard software sector relied on accessing and transforming external knowledge and committing investors while pursuing a flexible strategy in order to exploit opportunities and offset the underinvestment of knowledge, capital and labour resources. Entrepreneurs in the middleware sector relied on strategic flexibility, external knowledge transformation and strong reputation as innovators to reap the full benefits from an environment of opportunities, lack of constraining regulations and exploit competitive advantages relative to other sectors as a result of low capital and knowledge needs.

How do these sectoral and institutional conditions interact? The interaction between the institutional and sectoral conditions can directly be observed in the empirical findings. Whereas the institutional conditions very clearly set the range of

capabilities, sectoral conditions affect the extent to which these capabilities matter for innovation. All five capabilities are important for developing innovations across sectors to the effect that these five capabilities are credibly developed within this local institutional regime. Moreover, the institutional regime appears to shape innovative capability development to a large extent because even across sectors where technological and market characteristics are substantially different - and the requirements for innovative activities are distinct - we find the same five innovative capabilities. These findings support and qualify the roles of technological - and institutional regimes. The sectoral conditions determine how important each capability is whereas institutional conditions set the range of potential capabilities. Considering the link between institutions and capabilities, it is useful to explore in more detail their connections between.

Proposition 9: The successful development of innovation is based on the singling out of critical resources, such as human, financial and knowledge resources.

Proposition 10: Innovative capabilities are developed for re-configuring critical resources in response to changing institutional and sectoral conditions.

Proposition 11: Institutional conditions define the range of credibly developed capabilities. Sectoral conditions affect the extent to which these capabilities influence particular kinds of innovation.

10.5.2 Capabilities and institutional arrangements in Hangzhou

A crucial question then is why these five capabilities could be credibly developed in Hangzhou's business environment. Which features of Hangzhou's business environment necessitate and/or allow these capabilities to be developed? The findings in Chapter 9 already indicated several connections between capabilities and institutions. More precisely, the interviews and data suggest that a specific capability, for instance, reputation development, is developed in response to specific institutional constraints, for instance, lack of collective market knowledge. To go one step further, we can combine the findings from Chapter 6, on Hangzhou's institutional environment, with those from Chapter 8, institutional constraints, and Chapter 9, innovative capabilities, to identify several connections between capabilities and specific institutional features in Hangzhou (**Table 10.1**).

Table 10.1 - Connections between capabilities and institutional features in Hangzhou

Capabilities	In response to institutional conditions…
Organizational integration:	• Incomplete labour markets: recruiting and retaining employees • general scarcity in competences • limited by increased professional skills training • weak IPRs: need to build strong organization specific advantages • high workplace mobility
Financial commitment:	• Weak venture capital and banking market • Financial system biased towards private and foreign investments • Emerging sectors with need for capital, especially for labour costs • Preferential policies, government subsidization and tax benefits • Strong competition for private and foreign capital
External knowledge transformation:	• Lack of market know how, especially finding customers • Limited accumulated knowledge, need for external sources • Inexpensive way of learning: elite universities, talents • Emerging sector with new technologies and knowledge • technology zones and parks • Lack of government intervention: knowledge instead of influence
Reputation development:	• lack of market knowledge, so larger role for reputation • individual experience: a valuable asset given the 'newness' • organizational reputation necessary for getting finance, labour and knowledge in relatively incomplete labour and financial markets
Flexible strategy:	• many opportunities in an emerging market • lack of established business practices • changing (institutional) rules, need to be adaptive • weak IPRs, swiftness and first-to-market advantages are significant

Hangzhou's institutional conditions facilitate the credible development of these five capabilities. The findings indicate that in fact Hangzhou's institutions provide enough capital, labour and knowledge resources, i.e. sufficient available resources at the local level. In Chapter 6 we saw that Hangzhou has elite universities, relatively strong and rich local labour resources, presence of domestic and foreign R&D institutions, professional skills trainings and high availability of private capital and foreign investments. However, the mechanisms that link these resources to the software entrepreneurs are incomplete and ambiguous. Evidence from Chapters 6 and 8 shows that the labor market is inefficient because it lacks coordination via agencies or local government, the prevalence of informal agreements and networks, high labour turnover and uncertainty with respect to the capabilities of employees. Furthermore, there is considerable asymmetric information in the market, where government agencies (capital), business (knowledge and labour) and universities (labour, knowledge) all have parts of information and provide partial access to key resources, i.e. resource coordination uncertainty. Moreover, private entrepreneurs face relatively

low legitimacy in labour and capital markets dominated by state owned firms and foreign firms. The influence of the local government on the local economy is limited and has not resulted (yet) in stable formal institutional conditions that coordinate the markets for resources.

In response to these 'missing links' firms develop capabilities to act as functional equivalents of such mechanisms. A capability 'takes over' the function of connecting and coordinating resources, a function that is reserved for institutions in stable developed economies. This finding fits our definition of capabilities as they integrate, build and transform internal and external resources, i.e. a strong coordination element in the definition. It is useful to explore these connections in more detail.

The organizational integration capability is a response to institutional conditions that lower the commitment of employees and reduce the motivation to develop firm-specific competences. For instance, uncertain recruitment, high turnover of employees and high workplace mobility lower organizational commitment. Furthermore, limited professional skills, scarcity of general competences and a business environment with a low protection for specific investments reduce the motivation to develop firm-specific competences. The organizational integration capability lowers these constraints as it commits employees to the firm and contribute their resources to engage in firm-specific learning.

The financial commitment capability is a response to institutional conditions that create emerging incomplete and biased financial markets. For instance, weak venture capital and formal banking markets, emerging sectors with high need for capital, preferential policies, government subsidization and tax benefits that create an incomplete market. Furthermore, the financial system is biased towards private capital and foreign investment and therefore has strong competition for private and foreign capital. The financial commitment capability lowers these constraints as it commits internal and/or external sources of financial capital for investment as to assure the collective learning necessary for innovation.

The external knowledge transformation capability is a response to institutional conditions that create underinvestment in technical and market knowledge. For instance, lack of market know how, especially finding customers (business knowledge), limited accumulated knowledge and emerging sector with new technologies and knowledge. The external knowledge transformation capability then lowers these constraints as it allows the firm to acquire and transform knowledge across firm boundaries. The external knowledge transformation offsets the underinvestment in technical and market knowledge by learning from domestic and foreign companies or commercialize university research findings.

The reputation development capability is a response to institutional conditions that created low legitimacy for software entrepreneurs in local labour and financial markets. The reputation development capability then lowers these constraints as it enables firms to pursue innovative goals by developing and subsequently employing 'reputational assets' in the market.

The strategic flexibility capability is a response to institutional conditions that fail to coordinate an emerging sector with ambiguous rules and regulations and fast technical and market changes. For instance, lack of established business practices, changing policies, weak protection of investments in stable and long term skills and capabilities. The strategic flexibility capability lowers these constraints as it allows firms to change strategic directions to adapt to changing economic and institutional changes.

In sum, these five capabilities are credibly and likely to be developed in this particular institutional environment. The findings add insights into the connection between innovative capabilities and institutional conditions.

Proposition 12: Innovative capabilities are complementary to those institutions that govern and coordinate critical resources.

10.6 A new Chinese model of private-sector driven innovation?

How does this analysis change our ideas about innovation in a Chinese context? It is useful to summarize the 'standard model' of the origins of innovativeness within the Chinese context. Previous research mostly stays at the national level, indicating the various weaknesses in institutional mechanisms to mobilize critical resources for innovation (Liu and White, 2001; OECD, 2007). In Chapters 1 and 3 we have seen that China's institutional transition leaves firms with a lack of resources, missing property rights for resources and an uncertain governance of those resources. As such, firms in transition economies face increased uncertainty, opportunism and higher search costs for resources (Roth and Kostova, 2003; Peng, 2003; Stark, 2001). Why we find innovation in such a context is usually explained by macro-economic development such as international investments and technology spill-over, emerging private entrepreneurship and increased state support. Studies at the micro level indicate the role of interaction with the (local) government and state institutes, business networks, technical absorptive capacity and the role of 'necessity' for enhancing innovativeness of Chinese firms.

At the macro level, first, the role of international investments and technology spill-over (Liu and Buck, 2007), the inflow of foreign capital and technologies from Japan and USA in the late 1990s and returned overseas Chinese engineers (Saxenian, 2006) are considered important drivers of innovation. Other studies analyze latecomer

strategies and strategies for technological catching-up (Li and Kozhikode, 2008), implying that innovation in China is about absorbing existing technologies, imitation and following other countries and firms. Second, since the mid-1990s a significant private sector has emerged in China (Tsui, Bian and Cheng, 2006). Private entrepreneurship puts enterprises at the centre of an emerging innovation system that increasingly focuses on commercializing newly developed (state) technologies (Gu, 1999; Liu and White, 2001; OECD, 2007). Third, the role of the state in facilitating innovation has often been mentioned. Deregulation of the high-tech sectors, liberalisation, tax exemptions and (direct) subsidisations of firms or activities have played an important role boosting the performance and innovativeness of the high-tech sectors (Lu, 2000; Kreamer and Dedrick, 2001).

Firm level explanations of innovation suggest that coordination and interaction with the government and state institutes creates a crucial advantage for securing technical and financial resources and for getting access to markets (Li and Atuahene-Gima, 2002; Saxenian and Quan, 2005; Krug, 2007; Wan, 2005). Lu (2000) has shown how computer hardware firms used their collective/public nature that allowed extensive managerial autonomy, learning from foreign joint-ventures and access to state S&T resources. More generally, Stiglitz (1999) has argued that 'crop sharing' contracts between government and business provide incentives for innovation. Second, studies focusing on Chinese innovation and entrepreneurship stress the role of various kinds of informal business networks in overcoming the constraints of a weak institutional environment (Peng and Luo, 2000; Tan, 2005; Xin and Pearce, 1996). The alliances between economic and/or political players can help to overcome resource constraints, institutional deficiencies and fill institutional voids. Third, necessity is the mother of innovation in China, as recent research on strategic decisions in Chinese private ventures has shown (Meyer and Peng, 2005; Tan, 2005; Yam, Guan, Pun and Tang, 2004). Opportunity recognition and strategic swiftness are important factors for innovative ventures to not only compete with resource-richer SOEs, and foreign firms, but also for coping with (in)direct political constraints and limitations in resources (Batjargal, 2007; Krug and Polos, 2004). Last, technical absorptive capacity of firms cannot be overlooked in facilitating innovativeness, as suggested by Wan (2005) and Tan (2005). Especially the absorptive capacity of the firm for foreign technology is crucial for firms' innovativeness (Wan, 2005).

In contrast to the studies cited above, the findings on innovation in Hangzhou encourages scholars in innovation management to rethink basic elements of this 'standard model'. The key difference to other studies is that we focus on *private sector driven innovation*. Moreover, we combine perspectives on technological and institutional change by studying innovation at the firm level. The findings in this

research suggest that the origin of innovativeness of private entrepreneurs in Hangzhou lies in four factors.

Private entrepreneurs gain legitimacy as innovators by building a strong reputation of the firm in the local business community. Legitimacy in new markets depends on the reputation of the firm, for example to establish viable relations with suppliers and customers. As a complementary effect reputation mitigates uncertainty and market imperfectness in the whole local business community (cf. Lichtenthaler and Ernst, 2006).

Private entrepreneurs secure the appropriability of the innovation rents by creating organization-specific capabilities. In general, the literature shows that firms need to transform individual capabilities into collective, firm-specific skills. Our results suggest that the crucial aspect is the coordination and reconfiguration of employees' individual skills and firm-specific skills. This capability is a response to weak intellectual property rights, high labour turnover and competence uncertainty.

Private entrepreneurs mobilize knowledge resources for innovation by employing extensive formal and informal business networks that facilitate the reconfiguration of critical resources. These networks function as mechanisms to overcome asymmetry in information and knowledge markets. More precisely, to find ways for searching for business opportunities, the location of critical resources (including financial, human and knowledge resources) and the ways to access such resources (for instance, through university professors, local investment agencies, state research institutes, etc.). Networks connect political and economic actors yet in Hangzhou mostly economic actors. In short, the reconfiguration and transformation of knowledge across firm boundaries allows firms accumulating the critical knowledge, human and financial resources for innovation.

Private entrepreneurs attempt exploiting opportunities by being strategically flexible, on the one hand, and creating organizational and financial commitment on the other hand. Flexibility and stability must not be mutually exclusive. The long term commitment of financial and human resources facilitate collective learning necessary for innovation. The development of organization-specific capabilities therefore not only secures appropriability of innovation rents but also creates a frame for learning.

The four features that describe innovativeness are contingent to sectoral and institutional conditions. There is a distinct path dependency at the local level: Whereas China still follows a centralized and socialist type of economic development, Hangzhou is characterised by competition, entrepreneurship and innovation.

Institutional constraints for private entrepreneurs function not similar across sectors, which explains why distinct sectors show different innovation patterns. In short, in addition to a variety in institutions, sectoral differences matter for

understanding innovation in China (and elsewhere – cf. Malerba, 2004). Lastly, constraints can function as 'innovation triggers'. While sectoral and institutional risks are often considered to inhibit innovation, our study shows that sectoral, organizational and institutional risks trigger innovation.

All in all, the analysis suggests the following dimensions of private-sector driven innovation:

- *Legitimacy facilitating innovation and learning*
- *Steady appropriability of the innovation rent secured by the capabilities to reconfigure critical resources*
- *Knowledge networking as a way to search for critical resources and as a link between the local state and firm interest*
- *Searching for complementarities between flexibility and stability*

10.7 Insights from the 'China experience' for innovation management

The key contribution of this thesis is in the field of innovation management. One of the key insights is that *innovation is possible in an environment with institutional uncertainty and limited protection of property rights because, on the one hand, institutional uncertainty creates both restrictions and incentives for innovation, and, on the other hand, firms are able to develop specific innovative capabilities that manage sectoral constraints while fighting off institutional constraints*. Conceptually this suggests that an explanation of innovation should combine insights from capability theories with institutional analysis and sectoral studies of innovation. In what follows we will discuss each of these insights.

Whereas literature focuses on technical innovation, using patents, R&D inputs/outputs and new products as measures of innovativeness (Fagerberg, Mowery and Nelson, 2007), this study emphasizes organizational innovation as important. The weakness of incremental technical innovation is compensated by radical organizational innovation in the form of the capabilities to reconfigure critical resources.

Capabilities matter for innovation. Whereas technical and institutional conditions influence the innovation process, it is capabilities at the firm level that explain the underlying mechanisms. Three insights stand out.

First, the innovative potential of a firm depends on the complementarity of innovative capabilities. The five capabilities as examined above (organizational integration, financial commitment, external knowledge transformation, reputation development and flexible strategy) are not single organizational processes, but form a

'configuration' of capabilities. In contrast to prior research, the analysis shows the limits of technology and R&D as the only capabilities for innovation (Lee, Lee and Pennings, 2001; Han, Kim and Srivastava, 1998; Gatignon and Xuereb, 1997).

Second, our findings qualify the roles of technological - and institutional regimes in a transition economy and how they can be usefully combined (Lundvall, 1999 and Whitley, 2007). All five capabilities are important for developing innovations across sectors, credibly developed within one local institutional regime. Institutional regimes affect the overall pattern of credibly developed innovative capabilities while technological regimes and sectors explain variety.

Third, the study contributes to a growing literature on the connection between micro-macro level mechanisms (e.g. Whitley, 2003; Hage, 2003; Locke, 1995; Casper and Murray, 2003, 2005). The analysis shows that, on the one hand, capabilities are being constrained by institutional arrangements (cf. Whitley, 2006), on the other hand, capabilities contribute to the building and sharing of critical resources. Moreover, capabilities reveal to which extent firms become agents in generating complementarities. Capabilities take over functions normally reserved for mature institutions, such as coordinating information and knowledge sharing. In other words, the results contribute to explaining the co-evolution between capabilities and institutions (cf. Krug and Hendrischke, 2008; Lewin and Volberda, 1999).

10.7.1 Insights from the 'China experience' for transition economies

The analysis shows why we find a wide variety of innovation at the firm and sector level despite the joint situational constraints of transition. The empirical findings of the study emphasize the double-faced character of weak institutions: restrictions and opportunities (cf. Coriat and Weinstein, 2002; Whitley, 2006). Certain institutional features, such as limited access to bank loans, limit the development of enterprise software firms, while less affecting middleware firms which therefore enjoy a competitive advantage. This finding qualifies research focusing on the 'weak' part of weak institutions (e.g. Nee, 1992; Stark, 2001; Xin and Pearce, 1996), stressing the positive incentives for searching for ways to overcome the weakness. All in all, this study shows that characterising China's institutions as 'weak' is misleading as 1) the effects of institutional change vary across sectors and firms with different resource requirements and 2) institutional change can both constrain and provide opportunities.

10.7.2 Insights from the 'China experience' for comparative institutional analysis

The concepts developed in the comparative institutional literature can be usefully employed and modified to explain economic organization and coordination in transition economies. More specifically, the general concepts of institutional embeddedness (Hollingsworth and Boyer, 1997; Granovetter, 1985) and institutional

structuring of economic activities (Hall and Soskice, 2001; Whitley, 1999, 2006) is useful for explaining the economic activity in a changing institutional environment. Institutional arrangements follow a certain logic of economic action (Whitley, 1999; Deeg and Jackson, 2006). The findings in this study provide strong evidence for path dependency in institutions and institutional change and suggest that a historical and rich understanding of innovation will lead to better explanations (cf. Lazonick, 2007).

One path dependency is the lack of an uniform business environment in China. Local business environments with diverging patterns of economic organization and coordination shape innovative developments. The variety between local business environments is even more pronounced when institutions are weak. Moreover, not only regional variety is considerable, sectoral variety is just as significant, contributing to the literature on local economic development (Crouch et al, 2004) and sectoral systems of innovation (Malerba, 2004). This suggests combining regional studies of economic development with sectoral studies (Fagerberg, Mowery and Nelson, 2007).

Lastly, the findings suggest an extension of the variety of capitalisms perspective to transition economies. However surprising it may be, Hangzhou's local business system show features of a local system with intense competition, high levels of innovation and entrepreneurship within the Central Communist Party State of China. Hangzhou can be characterized as a capitalist city without a functioning democracy, financial or labour markets (cf. Tsai, 2008). The study finds strong support for the claim that capitalism and market forces can evolve within a variety of political regimes. This suggests that the conditions for capitalism as outlined in Western economics textbooks need to be revised and need to focus on mechanisms instead of conditions to include functional equivalents of institutions in developed economies.

Table 10.2 - Contributions

Field	**Contributions**
Transition economies / China studies	- the consequences of institutional transition are not similar across firms and sectors: incorporate variety; - institutional change: restrictions and opportunities
Comparative institutional theory	- extension of institutional analysis in transition economy; - local business system: value of local perspective; - wider variety of capitalism: 'capitalism' without a functioning democracy and formal financial and labour markets
Innovation literature	- innovation is not limited to technical innovation but also includes organizational innovation; - weak property rights do not inhibit innovation
Capabilities literature	- complementarity of capabilities; - combination of sectoral and institutional perspectives; - co-evolution between capabilities and institutions

10.8 Explanatory power

The study's explanatory power is constrained by the location, time period of the research and sectors. First, the study is done in Hangzhou; for the purpose of this study Hangzhou is an appropriate research setting. However, the findings for the sectoral development cannot directly be used in other institutional settings. Even though the mechanisms are likely to be the same, the extent or type of constraints might differ across institutional settings. Therefore, it is expected that innovative capabilities also differ in response to different institutional constraints. However, it is likely that the mechanisms are similar. In line with Manion (1994), we expect that the lessons learnt from local samples can tell us something about mechanisms, or relations between variables, even though the local contexts might differ. It must be noted that Hangzhou is at the forefront of economic and technical developments and therefore is likely to be a benchmark for other regions, which increases the potential generalizability of this study. Nevertheless, further research in other localities should validate this expectation. Beijing, Shanghai and Shenzhen are candidates for a comparative study but also Nanjing and Dalian are important cities for software development.

Second, the study is time-bound. Innovation involves creativity, surprise and uncertainty. As a newly emerging software industry is dynamic and changing continuously, it is hard to predict to what extent constraints, technologies and regulations change. Even though I took a process explanation of innovation in the software sectors, it remains hard to predict where the sectors will be heading. We don't know precisely how the sectors will evolve beyond the time period studied in this project. Nevertheless, the mechanisms that were uncovered at least explain the processes and it is unlikely that those mechanisms will change rapidly. New empirical studies should incorporate longer time periods and include follow ups of this research to see how the sectors developed. Furthermore, the findings should be tested in other emerging sectors, such as biotechnology, where the technical constraints are different.

Third, the study is limited to successful firms. Successful in this study refers to firms that succeed to innovate at least once successfully. However, the explorative, inductive nature of our empirical study does not allow for comparing the patterns of innovative capabilities of these successful firms with unsuccessful – in terms of innovation – firms. Moreover, this study did not differentiate successful innovators from extremely successful innovators. Lastly, future research should also take into account 'serial' innovators or continuous innovation as opposed to the discrete types of innovation considered in this study. Nevertheless, this study identified several patterns of innovation at the firm level in relation to institutional conditions which can form a basis for further research.

10.9 Managerial implications

The suggestion for Chinese entrepreneurs on the basis of the findings in this thesis is that they could consider the development of non-technical innovations to exploit the opportunities of an emerging market while at the same time developing a set of innovative capabilities. Furthermore, Chinese entrepreneurs would best consider the variety of capability development across distinct sectors. Focus on developing a set of capabilities that give the firm a long term competitive advantage for innovation in a particular sector, instead of opportunistic, short term strategies to exploit 'chances of the day', shifting across sectors. The implication for foreign businesses is that Chinese firms can be innovative partners for the development of high tech products and services in knowledge-intensive industries. Furthermore, foreign businesses should be aware of alternative mechanisms of protecting innovations in China, such as extensive local embeddedness via local partnerships and the development of organization specific capabilities. The implication for policy makers inside and outside China is that incentives for innovation can be created in a variety of ways, depending on the specific local conditions and histories of development. The most efficient and effective set of incentives for innovation are locally embedded. Moreover, policy makers should consider both local and sectoral variety of innovation when designing policies.

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Appendix

Innovative capabilities of software firms in Hangzhou

RSM Erasmus University

Respondent number:
Date:
Name of the firm:
Website:
The firm's main products/services:
Type/nature of work:
Area of responsibility of respondent:

(I) FOUNDING OF THE FIRM

1. Please describe how the firm was established <open>
   => idea
   => source of funding
   => main challenges
   => factors most important for successful founding
   => who owns the firm?
   => is the owner also the manager?

2. How does the firm try to compete? <open>
   => competing on quality, costs, first-to-market, innovative leadership?
   => are the products/services mass market, niche market or extensively customized?
   => what is the target market?
   => cost model: how are revenues generated?
   => how is the product sold and distributed?

3. How many people are currently employed by the firm?
4. What is the present value of all assets in RMB?
5. Did the firm have to make any significant specific investments? (please specify the main source of funding of each investment)
   (P) Location; Physical assets; Brand name; Human assets; Investments for specific customers (dedicated capacity); Mutual understanding with external partner; Trust building with external partner

6. What is the firm's most recent annual turnover in RMB?
7. What is the firm's most recent profit in RMB?

(II) INNOVATIVE CAPABILITIES

Please tell us about the firm's innovations

8. Does the firm consider itself a pioneer, good at spotting new opportunities?
9. What type of innovations did the firm introduce?
   (P) new products in existing product/service line; entered new product/service line; new process improvements; new management techniques; new quality controls in production, other

For the questions which follow we would like you to focus on one innovation of the firm that is / has been crucial for the firm's development.

10. Please shortly describe the innovation <open>
    => type of innovation (see Q.9)
    => when?
    => who/what initiated the idea?
    (P) customers, universities, new hires, consultants, employees, management, academic research, conference visits, industry associations, other firms, other (specify)

11. Please explain which factors were important for the development of this innovation <open>
    => internal versus external factors
    => finance, employment, knowledge, regulation, marketing
    (P) in house development (incl. training); developed in cooperation with business partners; purchased; imitation; strong core technology; attracting new personnel; strong collective capabilities, experience, new knowledge from conferences and seminars; knowledge from academic sources; talking to other professionals; hired consultants; other (specify)

12. What were the key challenges for this innovation and how did you manage these challenges? <open>

13. Did the firm have to make significant specific investments for this innovation?
    (P) Location; Physical assets; Brand name; Human assets; Investments for specific customers (dedicated capacity); Mutual understanding between the firm and any external partner; Trust building between the firm and any external partner

14. Did the firm have to attract new personnel for this innovation? If yes, how much and from where?
15. Did the firm get patents for this innovation?
    (P) Chinese patents, US patents, European patents

16. Are collaborations with external partners necessary for innovation in your firm?

External partners

17. For the following we would like you to focus on **all** the external business relations which are, or have been, especially important to innovation in your firm. This may be a business partner, or an individual or organisation important to your firm for granting access to finance or other necessary resources, knowledge, social network, etc. Think about those business relations without which the development of innovations of your firm would be problematic. Please explain why and how **each** partner is important.

    a) type of partner
        (P) Other domestic firms, foreign firms, individual, universities, government, banks, R&D institutes, venture capital investors, business associations, other (specify)
    b) main purpose of cooperation
        (P) 1) business information; 2) financial resources; 3) labour resources; 4) (technical) knowledge; 5) political/regulatory information; 6) other (specify)
    c) duration of cooperation (in years)
    d) frequency of contact
        (P) 1) daily; 2) weekly; 3) monthly; 4) less often; 5) almost never
    e) use of formal contract
    f) why with this partner? Origin/basis of cooperation?
        (P) 1) family; 2) extended family; 3) classmate; 4) former colleague; 5) teacher/professor; 6) former employer; 7) other professional; 8) other (specify)
    g) costs / disadvantages of cooperation with this partner
    h) size of partner (small/large)
    i) sector (same/other)
    j) ownership
        (P) 1) private firm; 2) state-owned; 3) joint-venture; 4) collective owned; 5) foreign invested; 6) other (specify)
    k) please indicate which of the partners also cooperate amongst each other

Organization of work

18. How does the firm organize a typical assignment/project? <open>
    => standard operating procedure;
    => cooperation across departments;
    => cooperation across functions
    => project teams
    (P) diverse functional backgrounds, changing composition, R&D focused, etc.

19. What are the demographic characteristics of the firm's work force?
    => number of university educated employees
    => number of supporting staff
    => number of managers
    => number of temporary workers
    => labour turnover ratio

20. How do you know you hire good people? <open>
    => what are the most important requirements for new employees?

=> what is the main source of new employees?
=> does the firm easily attract new employees?
=> are formal labour contracts used?

21. How do you keep your employees? <open>
    => What are the main types of compensation / incentives systems?
    (P) fixed salary, bonus system, performance-based pay

22. How important is practical training as opposed to formal education?
23. Does the firm provide on-the-job training?
    => how many employees followed a training?
    => what kind of training?

24. To what extent are employees involved in decision making?
25. What are the key challenges of the organization of work (HRM) and how do you manage them?

26. Please list the 5 most important factors that have been significant for innovation in your firm. These factors can be internal or external to the firm. For instance, think about on the job training, an important business partner, interaction with the government, attracting new talents, commercialization of research, strong core technology, etc.

(III) BUSINESS ENVIRONMENT

Competitors

27. Who are the firm's main competitors?
    => number of competitors increased/decreased/remained stable?
    => did the competitors become stronger/weaker/remained the same?
    => state or non-state competitors?
    => location of competitors?
    (P) same city, province, national, international

28. Do these competitors often introduce new products/services? Give examples.
29. Can competitors easily copy the firm's products/services?
30. Do the competitors offer substitute products/services? Give examples.
31. How does the firm learn about the behaviour of its competitors? <open>

Customers

32. Who are the firm's main customers?
    => did number of customers increase/decrease/remain stable?
    => did their demand increase/decrease/remain stable?
    => state or non-state firms (in case of business customers)?
    => principal location of the customers?
    (P) same city, province, national, international

33. Do the customers' preferences frequently change? Give examples.
34. Are the customers frequently looking for new products/services?
35. Are the customers loyal to the firm's products/services?
36. How does the firm learn about the behaviour of its customers? <open>

Technology and knowledge base

37. Were there any significant changes in technology or knowledge base since the firm started its operations? Give examples.
    => who/what was the source?
    => is it related to an international - or domestic development?

38. How important are such changes for the development of your industry?
39. How important is it for the firm to match these changes?
40. Did the firm have to change the way it produces products or delivers services?
41. How does the firm learn about these changes? <open>

The legal and administrative environment

42. Is it clear who the supervisory (administrative/legal) agent of your sector is?
43. Are the national/local regulatory requirements straightforward?
44. Is the amount of regulation and policies to which the firm needs to comply high?
45. Are there any preferential policies that your firm also benefits from?
46. Are there any policies that inhibit the further development of your firm?
47. Do changes in national/local requirements/policies occur often?
48. How do you keep track of the (changes in) policies and requirements? <open>
49. Are you confident that legal mechanisms safeguard your firm's interests?
50. How important is (frequent) interaction with the government? <open>

51. Are any other interactions with administrative agents, like trade unions, workers' associations, business associations important? <open>
52. How dependent is your firm on state actions and policies? <open>
53. Would changes in local administration or government pose a threat to the firm? <open>

New industry

54. The software industry is a young and new industry. Can you tell us about the challenges en uncertainties of operating in such a new industry? <open>
    (P) access to finance, attracting employees, reaching customers, learning about competitors, insufficient regulations, other (specify)

55. Can the firm look to and learn from other firms in the industry?
56. Are there many successful firms that could serve as an example to the firm?
57. Do you think your firm has enough experience to operate properly? <open>

Challenges

58. Please describe what the firm's biggest challenge is and how you plan to manage such a challenge. <open>

杭州中小软件企业的创新能力

Respondent number:
Date:
Name of the firm:
Website:
请简要描述一下该企业的主要产品/服务:
企业从事什么工作?
您在组织内的职责范围?

(I) 公司建立的情况 (10 分钟)

1. 请描述公司建立的情况. 请说明
   => 为什么会有建立公司的想法?
   => 公司建立之初的资金来源?
   => 建立公司之初的主要挑战有哪些? 请举例说明
   => 成功创建公司的关键因素有哪些? 请举例说明
   => 企业的所有者是?
   => 企业的所有人也是经理本人吗?

2. 企业是如何竞争的? 请说明
   => 在质量、成本、占领市场机会、创新领导方面竞争
   =>产品是采取大批量生产方式还是针对某种市场需要进行生产还是个性化定制的
   => 企业的主要客户是?
   => 如何实现收入和利润?
   => 产品如何进行销售?

3. 目前该企业雇用了多少员工?
4. 目前的资产净值是多少 (以人民币计)?
5. 需要专门进行较大的投资吗? 请举例说明? (请给出每次投资的主要资金来源)
   (P)地点; 设施; 品牌; 人力资源; 为特定顾客进行投资; 企业与外部合作者的相互理解; 企业与外部合作者的信任建立 (公关); 其它 (请说明)

6. 企业 2006 年的营业额是多少 (以人民币计)?
7. 企业 2006 年的利润是多少 (以人民币计)? 税前_____税后_____

(II) 企业的创新能力(30 分钟)

请介绍一下企业创新方面的情况

8. 您认为您的企业在发现新的机会方面是行业的领先者吗?
9. 企业在哪方面的进行了创新?
   (P)在已有产品/服务线中增加新产品；增加新的产品/服务线；对流程进行改良采取新的管理技术；在生产中采用新的质量控制; 其它 （请说明）

对于以下的问题，我们将把重点放在对企业有重大影响的一次创新行为。

10. 关于企业进行过的创新请举一个例子说明
    => 创新类型（见 Q.9）
    => 什么时间?
    => 该创新主要源于什么?
    (P) 客户，大学，公司新进员工，咨询人员，具有创意的员工，管理层，其它（请说明）

11. 哪些因素在引进这些创新过程中发挥过重要作用.
    => 内部因素及外部因素
    => 资金，员工，知识，法规，市场
    (P)企业内部发展（包括培训）；发展了同商业伙伴的关系；采购；模仿；吸引新人才；从研讨会中获得知识；强大的核心技术；强大的集体力量；经验；从学术渠道获得知识；与其他专家谈话；聘请咨询专家; 行业标准，其它 （请说明）

12. 这次创新中所遇到的最大挑战是什么，如何面对这些挑战?
13. 需要为这项创新专门进行较大的投资吗？请举例说明?
    (P)地点；设施；品牌；人力；为特定顾客进行投资；企业与外部合作者的相互理解；企业与外 部合作者的信任建立

14. 这项创新活动需要新的人手吗？如果需要，那需要多少人手，如何找到这些人？
15. 企业为该创新申请过专利吗?
    (P) 中国专利，美国专利，欧洲专利

16. 合作在该创新中的重要性如何?

请介绍一下企业商业关系

17. 以下的重点在于：对公司或曾经对公司的创新非常重要的一些商业关系。可以是商业伙伴、个人或组织在为公司提供资金或其它资源、知识和社会关系等方面起了重要作用。请解释为什么这些合作伙伴很重要，如何重要？

a) 合作者类型
b) 合作的主要目的
c) 您认识这个合作者有几年了
d) 您们彼此多长时间见一次面
e) 合作是否签订正式合同
f) 为什么选择这个合作者？合作缘由/基础
g) 与这个合作者合作的代价/不利因素
h) 合作者的规模大小
i) 合作者所属行业
j) 该公司的性质
k) 若这些合作者之间中也存在合作关系，请用连接线进行标注.

合作者类型:1)其它国内企业；2)国外企业；3)个人；4)高校；5)政府；6)银行；
7)科研院所；8)风险投资家；9)商业协会；10)其他（请说明）

目的:1)商业信息； 2)资金来源； 3)劳动力资源； 4) (技术)知识； 5)政策 / 法规信息；
6) 其他

您们彼此多长时间见一次面: 1）每天；2）每周；3）每月；4）不经常；5）几乎不见面

合作缘由/基础:1)直系亲属；2）其他亲戚；3）同学；4）同事；5）老师；6）雇主；
7）其他同业且有联系的人员；8）其他（请说明）

合作者的规模大小: 小，中，大

合作者所属部门: 同个行业/其它行业

该公司的性质: 1)国有企业； 2)集体企业； 3)私营企业； 4)合资企业；
5)外商独资企业；6)其他

请介绍关于企业开展工作的一些情况

18. 企业是如何组织日常工作的？请说明
=> 有标准化的操作程序吗？
=> 各部门相互独立地还是合作地开展工作？
=> 基于职责的合作关系？

=> 是否采取项目组的方式开展合作？
=> 若采取项目组的合作，请解释如何开展这种合作方式

19. 企业员工的信息?
=> 本科及以上员工的人数
=> 管理人员的人数
=> 临时工和兼职员工的人数
=> 去年新招聘员工人数
=> 去年离职员工人数

20. 如何招到合适的员工? 请说明
=> 对新员工最重要的要求是什么？
=> 新员工的主要来源是什么？
=> 企业能较容易地招到新员工吗？
=> 是否使用正式的劳工合同?
=> 是否有试用期，多长时间？

21. 如何留住企业员工? 请说明
=>主要的薪酬类型是?
（P）固定工资，奖金，绩效工资
=> 劳动力成本占总成本

22. 相对于正规教育，培训或工作经验是否更重要？
23. 企业提供在职培训吗？
=> 有多少员工会参加这样的培训?
=> 什么类型的培训?
=> 在职培训的成本是如何分担的?

24. 员工在多大程度上参与决策过程?
25. 人事管理方面中最大的问题是什么，如何去解决这一问题?
26. 哪些因素在引进这些创新过程中发挥过重要作用（内部因素及外部因素)？比如：企业培训；发展了同商业伙伴的关系；和政府(频繁)的接触与联系；吸引新人才；从研讨会中获得知识；强大的核心技术；强大的集体力量；从学术渠道获得知识；与其他专家谈话；聘请咨询专家，等等.

（III）企业环境（30 分钟）

请介绍关于企业竞争对手行为的一些情况

27. 企业主要的竞争对手是?
    => 竞争对手的数量在：增加/减少/保持不变
    => 竞争对手的实力在：变强/变弱/保持不变
    => 竞争对手是：国有的还是非国有的？
    => 竞争对手的地区：(P）同一城市，同省，国内，国际

28. 这些竞争对手经常推出新产品/服务吗？请举例说明.
29. 竞争对手是否能够轻易模仿公司的产品或服务？
30. 竞争对手会提供替代产品/服务吗？请举例说明.
31. 企业如何了解竞争对手的行为？请举例说明

请介绍关于企业客户的一些情况

32. 企业的主要客户是?
    => 客户的数量在：增加/保持不变/减少
    => 客户的需求在：增加/减少/保持不变
    => 国有企业还是非国有企业（如果企业的客户是公司的话）？
    => 客户的主要地址（如果是企业的客户是公司的话）？

33. 客户的偏好经常变化吗？请举例说明.
34. 客户经常寻找新的产品/服务吗?
35. 客户对企业的产品/服务的忠诚度如何?
36. 公司如何了解客户的行为？请举例说明

请介绍关于您所在行业的技术和知识发展的一些情况

37. 从企业建立以来，您所在行业发生过重大的技术和知识变革吗？请举例说明.
    => 变革源自什么？
    => 该变革同国际/国内发展有关吗？
    => 这种技术和知识变革快吗？

38. 对您的行业而言，技术和知识变革的重要性如何?
39. 您的企业跟上这种技术和知识变革的步伐重要吗，有多重要?
40. 企业会被迫改变其生产产品/提供服务的方式吗？请举例说明?
41. 企业如何知道这些变革？请举例说明

请介绍关于企业的法规 和行政环境的一些情况

42. 您是否清楚地知道您所在行业的监管（行政或法律）机构?
43. 您对国家或地方的法规要求是否清楚?
44. 企业需要遵循的法规和政策是否很多?
45. 企业能否享受一些优惠政策？ 请举例说明
46. 是否存在一些政策会妨碍企业的发展 ？请举例说明
47. 国家或地方政策是否会经常发生改变?
48. 您如何了解这些政策或法规（及其变化）？请举例说明
49. 这些法律法规能够保护您企业的利益吗？
50. 和政府的接触与联系是否很重要 ？请举例说明
51. 和其它机构的接触与联系是否很重要，比如工会、劳工协会、商业协会? 请举例说明
52. 企业在多大程度上独立于政府行为和政策？请举例说明
53. 地方行政机构或政府的政策变化是否会对企业造成威胁？请举例说明

新兴行业

54. 软件行业是一个新兴行业。您能否告诉我们在这个新兴行业中由于不确定性所引起的困难和挑战。请举例说明
    (P) 融资、人力资源、客户、竞争对手，法规的不规范，其他（请说明）

55. 您觉得那些企业是软件行业的领先者？
56. 能从他们那里学到什么吗?
57. 您认为企业在经营方面是否拥有足够丰富的经验？请举例说明

最大挑战

58. 请您描述一下企业目前所遇到的最大挑战，以及您计划如何应对这个挑战. 请举例说明

SUMMARY (DUTCH)

Dit promotie onderzoek bestudeert innovatie en ondernemerschap in China. Ondanks een institutionele omgeving gekenmerkt door onzekerheid en zwakke bescherming van intellectueel eigendom kan innovatie goed gedijen in China's technologiegedreven sectoren. We zijn op zoek gegaan naar verklaringen voor hoe deze innovatieve competenties ontwikkeld worden in een omgeving die innovatie niet lijkt te ondersteunen. Het onderzoek is tweeledig: het theoretische gedeelte richt zich op een synthese van competentie, institutionele en sectorale perspectieven op innovatie. Het empirische gedeelte omvat twee jaar intensief veldwerk in samenwerking met 45 Chinese ondernemers en Zhejiang Universiteit in Hangzhou.

Een van de belangrijkste inzichten is dat innovatie, in de brede zin van het woord, prima kan gedijen in een omgeving met institutionele onzekerheid en beperkte formele bescherming van intellectueel eigendom. Enerzijds creëert institutionele onzekerheid zowel bedreigingen als kansen voor innovatie. Anderzijds zijn ondernemingen in staat om specifieke innovatieve competenties te ontwikkelen om kansen en bedreigingen in de sector te managen en tegelijkertijd institutionele beperkingen het hoofd te bieden.

Dit onderzoek heeft vier specifieke resultaten. Ten eerste, Hangzhou heeft een ondernemers klimaat binnen het een-partij stelsel van China dat veel gelijkenissen heeft met een kapitalistisch systeem omdat het de juiste impulsen aan ondernemers geeft om te innoveren. Ten tweede, de Chinese ondernemers herinneren ons eraan dat innovatie niet beperkt is tot technische innovatie maar ook innovatie van organisatie kan zijn. Daarnaast laten de resultaten zien dat succesvolle innovatie niet beperkt is tot omgevingen met sterke formele bescherming van intellectueel eigendom. Ten derde, beperkingen gerelateerd aan de sector en institutionele omgeving kunnen een impuls geven aan ondernemers om te innoveren. Ten vierde, succesvolle innovatie benut een combinatie van competenties die de integratie en transformatie van kritieke bronnen – financieel, menselijk en kennis kapitaal - voor innovatie ondersteunen en versterken.

De resultaten van dit onderzoek kunnen gebruikt worden door internationale ondernemingen, Chinese ondernemers en beleidsmakers binnen en buiten China. Internationale ondernemingen moeten China niet langer zien als de fabriek van de wereld maar als potentiële partner voor de gezamenlijke ontwikkeling van innovatie. Chinese ondernemers mogen de toegevoegde waarde van het ontwikkelen en commercialiseren van niet-technische innovaties om de mogelijkheden van China's groeiende markt te benutten niet onderschatten. Tegelijkertijd stelt dit hun in staat om een coherente set van innovatieve competenties te ontwikkelen. Beleidsmakers kunnen lering trekken uit het feit dat het creëren van een omgeving voor innovatie op vele manieren gedaan kan worden, zolang het lokaal geïnstitutionaliseerd is.

SUMMARY (CHINESE)

本书的研究主题是中国的创新和创业。在法规制度不明晰的背景下，中国企业甚至是科技型企业依然如火如荼地进行着创新。他们是如何在这种不利的法制环境下开发自身创新能力的呢？这是一个值得探究的问题。为此，作者亲赴中国杭州，花了两年的时间，在当地最高学府：浙江大学的通力合作下，走访调研了45家当地软件企业，与CEO及业界精英们进行了面对面的深入交谈。综合调研结果，并利用关于公司能力、机构制度、行业部门三个要素在推动创新上的理论，写成了本书。本著作的其中一个关键思想是：在法规制度不明晰、知识产权不受保护的环境下，广义上的创新仍然是有很大空间的。原因有两方面，一是法规制度的不明晰虽然不利于创新，但也更加激发了创新的动机；二是在不利的环境下，企业仍然能够以变通的方式规避行业内和法制上的限制，开发具有当地和自身特色的创新能力。

此外，本著作主要有四点发现：一，在一党治国的中国，杭州有着极其类似资本主义的商业环境，激励着创新和创业行为；二，中国企业家认为创新不仅仅是技术上的创新，而且还包括组织上的创新；成功的创新不依赖于外界环境对知识产权是否具有强有力的保护。三，行业上和法制上的限制也能转化为创新动机。四，进行成功创新需要对企业关键能力进行合理配置，这里的关键能力是指企业对关键资源进行构建、转化和集成的能力，并且这些能力能够相互支持和加强。本著作对商业社会中的三个对象：外国企业、中国企业家和中外的政策制定者，有着潜在的贡献。表现方式如下：外国企业完全可以考虑与中国企业建立在创新方面的合作，而不仅仅把中国限定为世界工厂；中国企业家应该更加重视非技术型创新及其商业化，在此基础上大力开发一系列可持续的创新能力，挖掘自身在新兴市场上的机遇；而对于中外政策制定者来说，则应该因地制宜地设计创新激励机制。

ABOUT THE AUTHOR

Mark J. Greeven (Schiedam, September 4, 1981) obtained his M.Sc. degree in Business Administration from Erasmus University, The Netherlands. He became a Ph.D. candidate at the Department of Organization and Personnel Management, Rotterdam School of Management, Erasmus University in 2004. His Ph.D. project was a sub project of the NWO Shifts in Governance project. Mark has spent considerable time in Hangzhou, China for doing PhD field work in cooperation with Chinese entrepreneurs and the School of Management of Zhejiang University: August 2005 – August 2006 and September 2007 – December 2007. Furthermore, he was a visiting professor at the National Institute for Innovation Management of Zhejiang University in December 2008- February 2009.

Mark's research deals with innovation and entrepreneurship in China. Despite an institutional environment characterized by high levels of uncertainty, innovation thrives even in the technology-based sector. The research asks for explanations how innovative capabilities are developed in such an adverse institutional environment. He has presented his work at major international and Chinese conferences (EGOS, SASE, ISMOT, CICALICS, IACMR) and held seminars at famous Chinese universities, such as Zhejiang University, Fudan University and Qinghua University. He has published his work in book chapters with Edward Elgar and Springer and international academic journals such as European Management Journal and is currently working on a special issue article for Management and Organization Review. Next to publishing in academic outlets, he frequently appears in the Dutch media (Volkskrant, Trouw, RTL-Z, Chinese Radio and TV).

Mark is currently an assistant professor at Rotterdam School of Management, Erasmus University, member of the RSM Research Centre on China Business and academic coordinator of a new master programme Chinese Economy and Business.

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INNOVATION IN AN UNCERTAIN INSTITUTIONAL ENVIRONMENT
PRIVATE SOFTWARE ENTREPRENEURS IN HANGZHOU, CHINA

The thesis deals with innovation and entrepreneurship in China. Despite an institutional environment characterized by high levels of uncertainty, innovation thrives even in the technology-based sectors. The research asks for explanations how innovative capabilities are developed in such an adverse institutional environment. The thesis is based on a synthesis of capability, institutional and sectoral approaches to innovation and 2 years of extensive field research in cooperation with 45 Chinese entrepreneurs and Zhejiang University in Hangzhou. One of the key insights is that innovation, in a broad understanding, can take place in an environment with institutional uncertainty and limited formal protection of intellectual property rights. On the one hand, institutional uncertainty creates both restrictions and incentives for innovation, and, on the other hand, firms are able to develop specific innovative capabilities that manage sectoral constraints while fighting off institutional constraints. More specifically, this thesis has four sets of findings. First, the findings show that Hangzhou has a business environment within the one-party state of China that is closely resembling a capitalist business environment and provides incentives for innovative behaviour and entrepreneurship. Second, the Chinese entrepreneurs remind us that innovation is not necessarily technical innovation but also organizational innovation and that successful innovation is not restricted to environments with a strong formal protection of intellectual property rights. Third, sectoral and institutional constraints on innovation can also set incentives for entrepreneurs to innovate. Fourth, the successful development of innovation requires a configuration of capabilities that support and reinforce each other in the integration, building and transformation of critical resources. The thesis provides insights that can be used by international firms, Chinese entrepreneurs and policy makers inside and outside of China. International firms should not only consider China as a factory of the world but as a potential partner in joint innovative activities. Chinese entrepreneurs should consider the value added of developing and commercializing non-technical innovations to exploit the opportunities of an emerging market while at the same time developing a sustainable and coherent set of innovative capabilities. Policy makers should consider that incentives for innovation can be created in a variety of ways.

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