



Factors influencing technological entrepreneurship capabilities

Technological entrepreneurship capabilities

Towards an integrated research framework for Chinese enterprises

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Abstract

Purpose – This study seeks to address the issue of the factors influencing Chinese enterprises technological entrepreneurship capabilities. This study is particularly relevant in light of the driving role given to enterprises in the process of transforming China into an innovation-oriented nation and leading science power.

Design/methodology/approach – The paper draws on a broad literature review, covering various theoretical fields in International as well as Chinese management literature, to develop an integrated research framework. Relying on a multi-disciplinary and multi-level approach, the framework highlights a number of internal processes and external network attributes, their interactions and moderating relationships as related to their impact on Chinese enterprises technological entrepreneurship capabilities and their contributions to business performance.

Findings – The paper offers an overview of the factors that affect technological entrepreneurship capabilities, with particular reference to Chinese enterprises. Also, the study highlights some understudied issues and points to a number of research directions of specific relevance for the Chinese context. In this aim, a number of theoretical propositions have been identified.

Originality/value – The paper provides an integrated multi-disciplinary and multi-level research framework that organizes the body of knowledge, scattered in different literature and contexts, in a state-of-the-art piece of the research into technology entrepreneurship capabilities, as well as to identify more specific research questions, model, testable hypothesis and related studies that build on and add value to previous research.

Keywords Innovation, Technology led strategy, Information technology, Entrepreneurialism, China

Paper type Literature review

Introduction

The field of entrepreneurship has been organized around a central research question:

RQ. How opportunities for the creation of goods and services are formed and exploited (Shane and Venkataraman, 2000)?

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In addressing this question, there is now wide-spread agreement that changes in technology (technological advances) are among the key sources that contribute to the market imperfections which lead to the formation of entrepreneurial opportunities (Kirzner, 1973). Considerable literature has demonstrated the positive relationship between technological advances and firm profitability (Cefis and Ciccarelli, 2005; Geroski *et al.*, 1993; Roberts, 1999).

However, the fact that vast and increasing amount of inventions and technologies become available each year – for example over 160,000 patents were filed to the World Intellectual Property Organization in 2008 according to the organization's 2009 data – suggests that, the mere creation and development of technologies, by themselves, do not automatically ensure value creation. The key challenge for enterprises is rather how to best exploit and transform the promising technologies into new products and processes (Zahra and Covin, 1993) and expedite the introduction of new products to the market (Stevens *et al.*, 1999). Technologies are only more likely to contribute to value creation when they are successfully commercialized (Zahra and Nielsen, 2002; Gans and Stern, 2003), and only when the capabilities to successfully commercialize those technologies are heterogeneously distributed across firms (Barney, 1991). While the technology-based entrepreneurship literature continues to develop, the micro-macro link between technological opportunities and entrepreneurial performance has yet to be examined. This study is positioned to investigate the factors that influence firm's technological entrepreneurship capabilities and their contribution to competitive advantage in Chinese context. Technological entrepreneurship capabilities in this paper are defined as the capabilities to identify and exploit technological opportunities to create new or significantly improved products and to successfully commercialize them. We believe that realizing the key role of technology in fostering entrepreneurship is only the first step, working out the analytical logic of its commercialization process and explicating the underlying mechanism come next, and this second step is more crucial for us to have a deeper understanding of the nature of the technological entrepreneurship.

The literature has suggested that factors influencing firm's technological entrepreneurship could be situated both inside (Doganova and Eyquem-Renault, 2009; Antoncic and Prodan, 2008) and outside the firm's boundary (Elfring and Hulsink, 2003; Tomes *et al.*, 2000; Kenney and von Burgh, 1999). Moreover, those factors have been found to be contingent upon formal and informal institutions such as the development of intellectual property protection, government policies and social norms (Gans and Stern, 2003; Zhang *et al.*, 2008; Allen, 2003), as well as environmental factors such as environmental turbulence (Castrogiovanni, 1991; Li and Atuahene-Gima, 2001). Consequently, it might be quite difficult to address our concerns by relying on just one theoretical perspective or level of analysis. As a matter of fact, a number of researchers have already tried to analyze the phenomena exploring different theoretical fields (Hindle and Yencken, 2004; Elfring and Hulsink, 2003; Lee *et al.*, 2001) and using multiple level of analysis (Yang *et al.*, 2010). However, none of those studies have explicitly attempted to investigate at the same time the interplay between internal and external factors (with the exception of Lee *et al.*, 2001) and the effects of institutions (with the exception of Li and Atuahene-Gima (2001)) and the desired effects of the relationships argued or found on performance.

Those are the reasons why, building upon this new body of research, a multi-disciplinary and multi-level approach is adopted in this work.

Technically, we did a thorough review of the literature, including academic publications in strategic management, entrepreneurship, social capital and technology and innovation management, as well as policy documents. A number of factors influencing specifically Chinese firm's technological entrepreneurship capabilities have been identified and arranged in an integrated and multi-level research framework at the interface of the above-mentioned theories.

The paper is organized as follows. First, the concept of technological entrepreneurship is introduced. Then, after a review of the current status of innovation capabilities in Chinese enterprises, factors influencing specifically technological entrepreneurship capabilities in Chinese firms will be discussed. Finally, the integrated research framework and a number of theoretical propositions will be presented. In the conclusions, possible research directions will be proposed.

Background

The technological entrepreneurship concept

Technologies, whether brand new or already existing, advanced or not, by themselves cannot automatically ensure value creation. The facts that most of them are readily available on the market, that imitators are often successful in reverse engineer, copy or reproduce them, and that there are a number of alternative ways to reproduce the same functions, suggest that tough technologies can be valuable, it is quite unlikely that they can also be at the same time rare, non-imitable and non-substitutable. Yet, what can be true in the factor market might well be different in the product market.

Technologies create value when they are transformed in new products, those products are rapidly introduced to the market and extra-profits for enterprises, appropriate returns for investors, rewards for inventors and ultimately benefits for the whole society are generated. In other words, scientific breakthroughs, inventions and technological development are essential for value creation and competitiveness, but it is the discovery of technological opportunities and their commercial exploitation that makes the difference. That is basically what technological entrepreneurship means: the transformation of promising technologies into value. More specifically, technological entrepreneurship (or its synonyms, i.e. entrepreneurship, techno-entrepreneurship, and tecnoentrepreneurship) consists of a set of behaviours and actions that drive the market process (and also a strategy) which is based on identifying high potential, technology-intensive commercial opportunities, gathering/assembling resource and managing rapid growth and significant risk with the final aim to exploit those opportunities for value creation (Antoncic and Prodan, 2008).

Following these considerations technology entrepreneurship concept is made of an entrepreneurial component, i.e. the enterprise's capabilities to recognize technologies' entrepreneurial and business opportunities and a management component, i.e. the enterprise's capabilities to develop compelling value propositions and business models made to exploit those opportunities. Those two set of capabilities makes together what is here referred as technological entrepreneurship capabilities, i.e. the capabilities to identify and exploit technological opportunities to create new or significantly improved products and to successfully commercialize them. These capabilities are here supposed to be rooted in a number of "high-performing organizational processes" (Bingham *et al.*, 2007) that bridge technology development and business creation:

[...] from the recognition or even the creation of potential business value of new discoveries and technologies, to the matching with existing and/or potential market needs, and finally the transformation of opportunities arising in commercial products, services and new businesses (Petti, 2009).

Altogether, making what Petti refers as the technology entrepreneurship process. Technological entrepreneurship capabilities and related processes transcend single individuals or enterprises and are inextricably linked and affected by the context in which they are deployed. This context is made of a specific set of local conditions, and a mix of relational and institutional configurations that affect technological development and entrepreneurship. So, there is also an environmental component to consider, i.e. the availability and the qualities of external institutions and resources that set the appropriate conditions for technological opportunities to be discovered and exploited profitably (Figure 1).

As a matter of fact, these opportunities do not emerge on them own, neither are them the result of (only) particularly talented, creative, and even lucky individuals, pairs of teams. Rather, these opportunities often emerge and are exploited as a result of a collective, systemic and systematic effort, which involves a number of interacting actors that provide the resources, set the appropriate conditions, and contribute to the development and diffusion of technological applications. They are, in the end, the result of a system. A system, the one that requires the interaction among talented individuals, government agencies, education and research institutions, enterprises as well as investors, would significantly facilitate and stimulate the diffusion of discoveries and technologies from where they are produced to where they are needed.

To sum up, the concept of technological entrepreneurship here advocated is made up of three components, namely entrepreneurial, managerial and environmental component, and the essence of the technological entrepreneurship is reflected on a system of interactive actors engaged in a set of activities related to technology development and identification, opportunity recognition, product development, business development and creation (Figure 1).

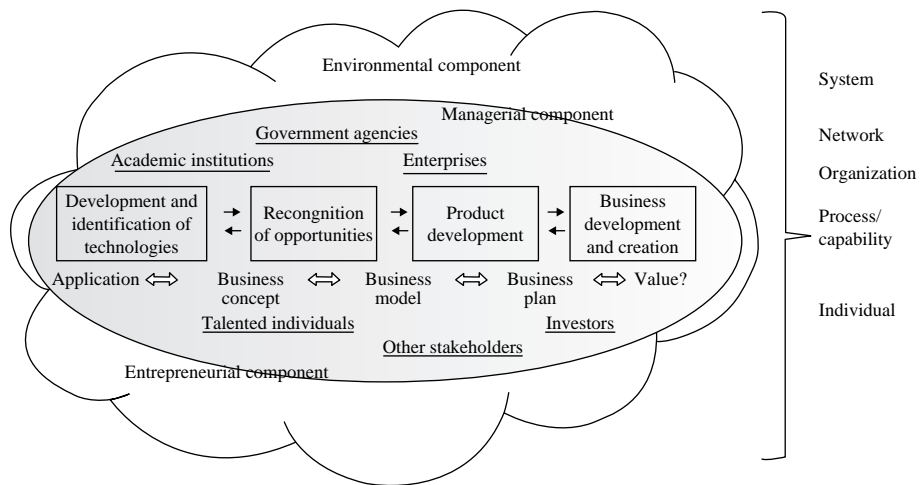


Figure 1.
A systemic view of technological entrepreneurship

Source: Adapted from Petti (2009)

Technological entrepreneurship in China: the role of enterprises and current situation
 As Figure 1 shows, in general technological entrepreneurship hinges on a system of diverse actors, with various and somewhat overlapping roles and a set of generic activities aimed at bringing technologies to market. The components and dynamics of such a system have been already depicted elsewhere, especially as related to the USA and EU (Petti, 2009).

In China, this system differs from the USA and EU ones in a number of aspects, mainly related to the role of some of the players involved that influences the system's dynamics. More in detail: the stronger role of governmental research institutions, the so-called transnational communities (Saxenian, 2002) and foreign enterprises in innovation and entrepreneurship activities. Those differences in roles also affect the way technological entrepreneurship works. For example, the peculiar relationship between government, science and industry inherited from the pre-opening reform period and, more in general, the strong drive of central and local governmental agencies. Figure 2 synthesizes the components and dynamics of the system for technology entrepreneurship in China, reporting the main players involved their roles, relevant examples and main interactions (represented by the arrows).

Talking about commonalities among US, EU and China systems for technological entrepreneurship, the most evident is the relevance given to enterprises, supposed to be the engines of such systems.

In China, the role of enterprises is becoming more and more relevant, as testified by:

- their strong direct contribution to research and innovation activities through funding, in-house research and outsourcing; and
- the increasing responsibilities and support given to them by the governments.

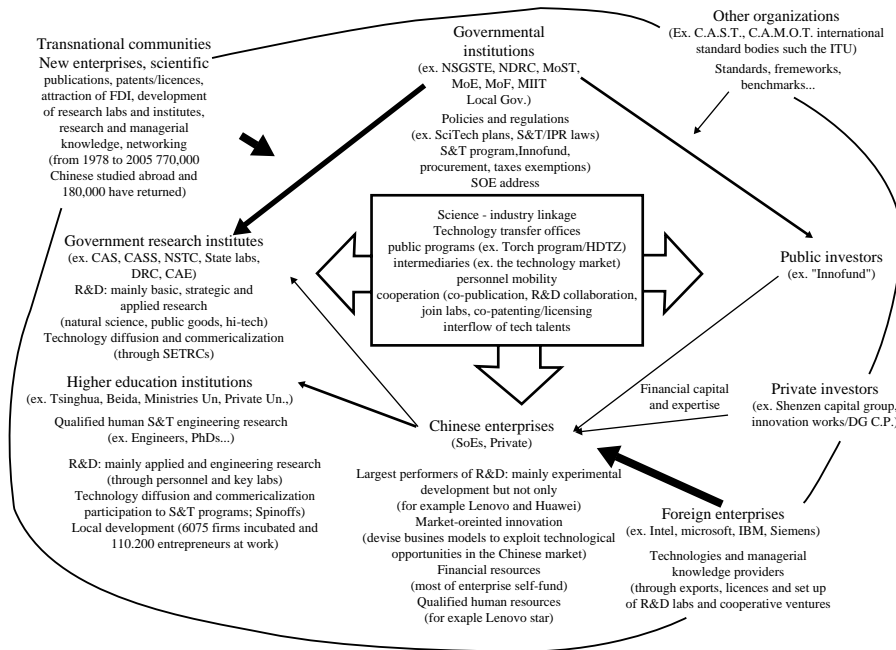


Figure 2.
 The system for technological entrepreneurship in China

As a matter of fact, enterprises provide about the 70 percent of R&D expenditure and about one-third of higher education and research institutes R&D spending (Schaaper, 2009). Moreover, enterprises have been recognized by the National Medium and Long-Term S&T Strategic Plan (2006-2020) to be the key driving force of “the transformation of China into a strong innovation-oriented nation [...] with strong indigenous innovative capacity” (Schaaper, 2009), and a number of mechanisms have been devised to help them to do so, aiming to increase their innovative capacity.

However, even if we can think of Chinese enterprises as being intensely “technologically entrepreneurial”, i.e. being particularly capable of the identification and exploitation of technological opportunities, this capability is mainly limited to the matching of existing technologies with specific local market needs. So, Chinese enterprises’ technological entrepreneurship capabilities whereas well developed as related to the entrepreneurship and marketing component, seem to be underdeveloped on the technology and R&D one. This is alleged to be as one of the main weaknesses of the Chinese technology enterprises that hinder their entering the international arena as well as domestic high-end markets. For example, it has been reported that from 50 to 70 per cent of the manufacturing cost of a Chinese PC is made of licence fees to Microsoft and Intel (OECD, 2008). Moreover, foreign-invested enterprises hold 29 per cent of the invention patents of the country and their development expenses, sales revenues and exports amount of the new products account, respectively, for 31, 41 and 60 per cent of those of the whole country in year 2009 (<http://big5.gov.cn>). This situation – elsewhere referred as “innovation indolence” (Guan *et al.*, 2009) – though recognized to be fitting with the peculiar characteristics of the Chinese market (Liu, 2008) and be beneficial to firm’s short-term profits and growth, is well clear to scholars and policy makers as a severe limitation in the competitiveness of Chinese enterprises and the country’s long-term development. Of course, there are notable exceptions – such as Lenovo, Huawei, ZTE and Haier – that clearly show as China’s enterprises sub-system has entered in what Xie and White (2006) call the creation stage, characterized by the development of proprietary technologies and internationally competitive valuable resources and capabilities. However, if the enterprises are to be the country’s innovation engine, their innovation capabilities, and in particular technological innovation capabilities, need to be improved. Even so, those technological innovations will still need to be brought to the market and successfully commercialized to create the benefits expected. That is why to address the challenges rose above, the identification of factors weakening or boosting Chinese enterprises capabilities to fully realize the market potential of technological innovations –, i.e. their technological entrepreneurship capabilities – is a first necessary step. In this aim, we engaged in a thorough literature review and developed an integrated research framework discussed in the sections that follow.

Methodology

In order to shed light on the issues posited and, possibly, identify some specific factors as related to the Chinese context, a multi-disciplinary and multi-level review of both international and Chinese academic literature and policy documents has been undertaken.

As a matter of fact, as mentioned earlier, technological entrepreneurship transcends single individuals or companies and the related capabilities are inextricably linked

and affected by the context in which they are deployed. This context is made of a mix of relational and institutional configurations as well as a specific set of local conditions that affect technological development and entrepreneurship. This suggests that the answers to the questions posed might be found inside as well as outside the enterprise and their relevance and effects might differ in different contexts.

That is why, we decided to explore diverse theories and contexts that give equal emphasis to internal, external as well as contingency perspectives. In particular, the review work consisted of in-depth study of academic research in received strategic management, social capital, entrepreneurship, and technology and innovation management literatures and the examination of policy documents and reports, especially those related to the Chinese context. The works to review have been selected in three ways:

- (1) Seminal works in the theoretical fields mentioned and related relevant references.
- (2) Full issues-scanning on the basis of recent studies on high-tech firms/companies/enterprises, new technology-based firms/ventures, innovation and technological capabilities.
- (3) Keyword-based search on academic electronic databases using keywords such as technological entrepreneurship, technology and entrepreneurship, technological entrepreneurship and China.

A literature database has been developed and mind-mapping of constructs, hypothesis/propositions and results have been undertaken to identify relevant factors, relationships and effects. Overall, more than a 100 academic studies and policy documents and reports have been reviewed.

The insights gained from this review work are synthesized in Table I and discussed in the next section.

Factors influencing technological entrepreneurship capabilities

As can be seen from that table, strategic management related literature focuses on the analysis of internal capabilities that can be thought of as “antecedents” or “components” of technology entrepreneurship capabilities, as well as a number of environmental and institutional factors moderating the relationships between those capabilities and competitive advantage. Social capital-related literature focuses on external networks characteristics that allows the identification of particular network configurations that might be more conducive to enterprise’s technological entrepreneurship capabilities, as well as other environmental factors moderating the relationships between those configurations and competitive advantage and also, more relevant for this study, the acquisition of competitive capabilities. The entrepreneurship-related literature focuses on both internal and external characteristics influencing the identification and exploitation of opportunities, allowing for the identification of further internal and external characteristics, conducive to both the technological opportunities identification and exploitation components of technological entrepreneurship capabilities.

The same is for technology and innovation management and multiple field studies-related literature that suggests the relevance of the study of the combined effects of internal capabilities and external networks characteristics on performance and entrepreneurial processes, including technological entrepreneurship.

Table I.
Literature review
summary table

Fields	Studies	Factors and relationships
Strategic management	<p>Teece (2007), Tsui <i>et al.</i> (2006), Wang <i>et al.</i> (2006), Wang <i>et al.</i> (2004), Marsh and Stock (2003), Zahra and George (2002), Zahra and Nielsen (2002), Li and Atuahene-Gima (2001, 2002) and Eisenhardt and Martin (2000).</p>	<p>Enterprises' internal capabilities: resources' combination and reconfiguration, opportunity search, business process upgrading, business model innovation, investments' decision making, technology, marketing, integration, customer value, (certain types) of organizational culture, knowledge management (in particular knowledge exploitation) human resources and manufacturing capabilities, product innovation strategy and logic of opportunity; often moderated by: learning orientation, technological turbulence, regime of appropriability, isolating mechanisms, product modularity, institutional support and environmental turbulence, dysfunctional competition, partnership-based linkages and political networking; in the relationships with: competitive advantage, usually expressed in terms of overall firm performance (either financial or market based, but also based on customer and internal measures) or in new product development performance (based on numbers and contribution), or both; Enterprises' external networks characteristics: strong ties, weak ties, mix of strong and weak ties, network position, network density, participation (into particular) networks, reciprocity, trust and interdependence, Guanxi and Mianzi, alliances with technology intermediaries, knowledge acquisition from customers, network composition; and enterprise's internal alliancing capability; often moderated by: level of uncertainty, but also industry's technological characteristics and complementary assets ownership; in relationship with: competitive advantage (in terms of either overall or new product development performance), network governance and structure and also acquisition of competitive capabilities;</p>
Social capital	<p>Hulsink <i>et al.</i> (2009), Siu and Bao (2008), Rosenkops and Schilling (2007), Buckley <i>et al.</i> (2006), Rothaermel (2001), Yli-Renko <i>et al.</i> (2001), Gulati <i>et al.</i> (2000), Rowley <i>et al.</i> (2000) and McEvily and Zaheer (1999)</p>	<p>Enterprises' internal characteristics (capabilities and attributes): superior opportunity identification and exploitation, entrepreneurial cognition/behaviour (i.e. entrepreneurs' heuristics-based logic, alertness, knowledge, effectuation); business model, entrepreneurial orientation, corporate and corporate technological entrepreneurship, and near-decomposability; enterprises' external network characteristics: cooperation and number of alliances, inter-firm communication, organizational support and value-congruence, density of potential partner's network; and external factors: technology, financial, human resources and market policies, strength and type of IPR regime, (lack of) control over complementary assets, national entrepreneurial culture and supporting infrastructure differentials; in relationship with: organizational performance (also expressed in terms of innovation performance), entrepreneurial activities, including technological entrepreneurship;</p>
Entrepreneurship	<p>Doganova and Eyquem-Renault (2009), Niu <i>et al.</i> (2009), Antoncic and Prodan (2008), Zhang <i>et al.</i> (2008), Yang <i>et al.</i> (2007), Gans and Stern (2003), Suzuki <i>et al.</i> (2002), Alvarez and Busenitz (2001) and Venkatraman and Sarasvathy (2001)</p>	<p>Enterprises' internal characteristics (capabilities and attributes): superior opportunity identification and exploitation, entrepreneurial cognition/behaviour (i.e. entrepreneurs' heuristics-based logic, alertness, knowledge, effectuation); business model, entrepreneurial orientation, corporate and corporate technological entrepreneurship, and near-decomposability; enterprises' external network characteristics: cooperation and number of alliances, inter-firm communication, organizational support and value-congruence, density of potential partner's network; and external factors: technology, financial, human resources and market policies, strength and type of IPR regime, (lack of) control over complementary assets, national entrepreneurial culture and supporting infrastructure differentials; in relationship with: organizational performance (also expressed in terms of innovation performance), entrepreneurial activities, including technological entrepreneurship;</p>

(continued)

Fields	Studies	Factors and relationships
Technology and innovation management	Guan and Chen (2010), Yu <i>et al.</i> (2009), Zhang <i>et al.</i> (2009), Altenburg <i>et al.</i> (2008), Liu (2008), Chen and Yuan (2007), Guan <i>et al.</i> (2009), Xie and White (2006), Tomes <i>et al.</i> (2000) and Kenney and von Burgh (1999)	Enterprises' internal characteristics: size and export ratio, low level of realized absorptive capacity, outsourcing and FDI, Balance between internal R&D and outsourcing (investments in) decision-making systems; enterprises' external networks characteristics: participation into global value chains and transnational professional communities, relationships with technology intermediaries, and external factors with mixed effects: (positive) government specific industry policies, presence of specialized institutions and suppliers (negative) top-down planning, agglomeration, lack of key technicians, innovation culture and incentive systems, weak enforcement of IPR & Contract Law, mobility of R&D personnel and key technicians (with a threshold effect first positive and then negative): market size and (easy) access to technologies or environmental munificence technology transfer; in relationships with: innovation activities, capabilities and performance and technological entrepreneurship
Multiple fields	Stam and Elfring (2008), Bingham <i>et al.</i> (2007), Zahra <i>et al.</i> (2006), Blyler and Coff (2003), Elfring and Hulsink (2003) and Lee <i>et al.</i> (2001)	Enterprises' internal capabilities: shared heuristics, opportunity recognition capabilities, dynamic capabilities; and enterprises' external networks characteristics: bridging ties and network centrality, structural holes and central network position, mix of strong and weak ties, moderated by (in one case): the degree of innovation; in relationship with: performance (in one case also internal process performance) and entrepreneurial processes, more in particular as related to the discovery and exploitation of opportunities

Notes: Main factors identified and hypothesized relationships; not all the studies indicated can be neatly attributed to one of the fields mentioned; as a matter of facts, more and more the boundaries between some disciplines are blurring, especially between strategic management, entrepreneurship and social capital fields; so, this classification issue have been tackled in two ways: (1) assigning studies with criteria of prevalence when doubts arisen; and (2) in adding the last column "multiple fields" that reports those studies in which the authors explicitly referred to the use of multiple fields for their investigations; the studies underlined – which indicate works that explicitly refer or study technological entrepreneurship – highlight what can be considered an emerging technological entrepreneurship literature that can be found as the intersection of entrepreneurship (mainly) and technology management fields

Table I.

Except for technology and innovation management-related literature, in which it has been found that the relationships between the factors and innovation activities, capabilities and performance are both positive and negative and sometimes characterized by some threshold effects, all the other studies generally unveils positive relationships between the factors studied and dependent variables, with few exceptions as related to:

- The general lack of moderating effect of partnership-based linkages (apart from linkages with venture capital companies) and political networking in the relationship between product strategy and performance, and the negative moderating effect of technological turbulence between marketing capabilities and performance in strategic management surveyed literature, both results found in Chinese enterprises.
- The contingent effects of most of the network characteristics advocated in most of the studies as related in particular to environmental uncertainty in social capital surveyed literature, that might be also applicable to Chinese enterprises.
- The negative effects of some national cultural traits on entrepreneurship in entrepreneurship surveyed literature, that might be applicable to the Chinese context.

For what concerns the Chinese context in particular first, in most of the academic studies and policy documents and reports surveyed, Chinese enterprises innovative capacity, with little distinction between technological and traditional ones, has been portrayed as being weak (Guan *et al.*, 2009; Li-Hua and Khalil, 2001; Wilsdon and Keeley, 2007; Chen and Yuan, 2007; Dobson and Safarian, 2008; OECD, 2008; Schaaper, 2009; Zhang *et al.*, 2009) or at best in transition (Altenburg *et al.*, 2008; Xie and White, 2006). A notable exception is the work of Liu (2008) where a contingency argument describe most of the claimed limitations of innovations in Chinese enterprises as being more a set of conscious responses to the peculiar characteristics of the Chinese's market environment and catch-up model. Nonetheless, also Liu, at the end of his work warns about the challenges raised by the current prevailing model, namely "the few radical innovation into the Chinese industry [...] This makes Chinese firms hollowing out of their core technology" and the still excessive reliance of government on universities and government research institutions as main technology providers that "makes companies to play a marginal role in frontier technology development".

Second, a number of factors underlying this generalized weakness of Chinese enterprise's innovation capacity, especially as related to technological innovation, have been highlighted in those studies. More specifically, those studies – mainly in technology and innovation management literature (Table I) – have unveiled a number of external institutional and environmental factors as well as some internal enterprise characteristics demonstrated or argued to be relevant. For example: the weak or uncertain protection of intellectual property and contract law enforcement as for institutional factors; the scarce mobility of key R&D personnel and technicians (between public research institutions and enterprises and between big state-owned and small and medium-sized private enterprises) or their excessive mobility (among small and medium-sized enterprises) as for environmental factors; the lack of adequate absorptive capacity especially in knowledge exploitation, lack of innovation culture and incentives or too much outsourcing as related to internal enterprises' characteristics.

Third, as an evidence of the transition that the Chinese enterprises system is undertaking, factors with positive influence have been identified. Those are not only institutional factors, in particular as related to government specific industry or technology and entrepreneurship policies, and more in general institutional support when and where available, but also enterprise level factors such as integration capabilities and learning prowess.

Fourth, the literature surveyed highlights the strong relevance of institutions, and in particular formal institutions on the innovative activities, capabilities and technological entrepreneurship. Whatever their effects are positive as for the government specific industry policies, or negative as for top-down planning, their relevance for the Chinese context is definitely high, to the point that other peculiar results – such as the negative effects of agglomeration on innovation activities found in the study of Zhang *et al.* (2009) – can be attributed to, among other factors, to (the lack of) institutional-based factors such as intellectual property rights (IPR) protection or contracts enforcement. Besides the strong relevance of institutions, another set of factors that seems to be peculiar to the Chinese context is the Chinese context itself, in terms of the size and growth, elsewhere referred to environmental munificence (Castrogiovanni, 1991) that, has already highlighted, influences Chinese enterprises strategies in ways often detrimental to innovation (Liu, 2008).

An integrated research framework for Chinese enterprises

Albeit the fundamental insights provided by the aforementioned works as related to Chinese enterprises' innovation capabilities, and the ones provided by received international literature in general, none of the China-related studies addressed specifically technological entrepreneurship at the enterprise level and few of all the studies surveyed have explicitly attempted to investigate the interplay between internal and external factors (with the exception of Lee *et al.* (2001)), including the effects of institutions (with the exception of Li and Atuahene-Gima (2001)) and the desired effects of the relationships argued or found on performance. There is so the opportunity and the need for more integrative research on technological entrepreneurship in general and on technological entrepreneurship in China in particular, at least if the objective is to unveil the factors underlying technological entrepreneurship capabilities. As the nature of those capabilities, the issue is complex and the field is vast and spanning different theories and national contexts. Exploring this issue in existing literature is like a treasure hunt, with a number of valuable clues and (theoretical) traps. A map would help a lot, and is how we conceive the integrated research framework developed in this work.

According to this framework, the factors influencing technological entrepreneurship capabilities in general and technological entrepreneurship capabilities of Chinese enterprises in particular can be classified into:

- enterprises' internal characteristics, for example absorptive capacity, entrepreneurial orientation or business model;
- enterprise's external network attributes; and
- environmental/institutional factors.

As a matter of fact, in today's changing competitive environments, firms begin to realize that possessing abundant resources is a necessary but not sufficient conditions to ensure success and even survival. Firms must be able to continuously leverage resources

from outside network to maintain competitive advantage. Those network attributes include the mix of strong and weak ties, network position or density. Moreover, in countries like China, business environments tend to be highly turbulent and uncertain, caused mostly by policy ambiguity, government intervention and institutional transition. The paradox of environmental turbulence on the one side and the importance of the environment to organizational performance on the other suggest that studies should also integrate environmental contingency logic into their research models. Those factors include the IPR regime, environmental turbulence or munificence and other institutional elements. This last category of factors has been often used as moderators of the relationships between enterprises' internal and external characteristics and dependent variables such as overall firm performance, new product development performance, acquisition of competitive capabilities, innovation capabilities and so on. No moderating effect has been found when technological entrepreneurship was used as a dependent variable.

This integrated research framework, made of the aforementioned factors, related relationships and hypothesis as related to their possible effects of technological entrepreneurship capabilities is shown in Figure 3. More in detail, the framework integrates insights from the strategic management, entrepreneurship, social capital and technology and innovation management theories, and the institutions-based view, in the following four components:

- (1) A set of specific internal processes embedding enterprises' entrepreneurial and strategic capabilities related, respectively, to the recognition, discovery and creation of technological opportunities and the development of compelling value

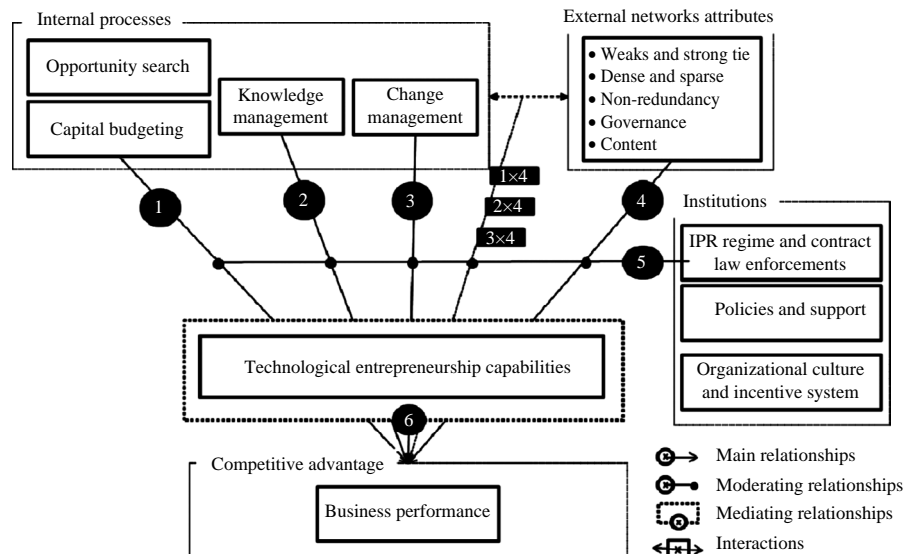


Figure 3.
An integrated framework for technological entrepreneurship in Chinese enterprises

Notes: Control variables: (1) Environmental munificence; (2) degree of innovation/environmental turbulence; (3) entrepreneur/founding team characteristics (i.e. education and experience, mainland and/or overseas, attitudes); (4) organizational age, origin (independent vs corporate), ownership (public or private) type (manufacturing/non-manufacturing-high technology/traditional technology), size; (5) tech./innovation strategy (internal R&D vs outsourcing)

propositions and innovative business models capable of exploiting these opportunities. More specifically, opportunity search and capital budgeting embedding entrepreneurial orientation (Lumpkin and Dess, 1996; Covin and Slevin, 1991; Miller, 1983); knowledge management, embedding absorptive capacity (Zahra and George, 2002; Cohen and Levinthal, 1990) and change management, especially as related to business model innovation, embedding dynamic capabilities (Teece, 2007; Eisenhardt and Martin, 2000; Teece *et al.*, 1997; Teece and Pisano, 1994).

- (2) A set of specific enterprises' external networks' attributes (Hulsink *et al.*, 2009), i.e. strong and weak ties, density vs sparsity, non-redundancy, governance and content. As a matter of fact, technological opportunities can be identified internally, mainly with R&D activities, as well as from a number of external sources. In either case, the reliance on external networks and the ways in which those networks are configured is paramount to get the necessary information and knowledge to recognize technological opportunities and to secure the resources and capabilities needed to transform those opportunities in real profits.
- (3) A set of formal and informal institutions (Peng, 2003; North, 1990), moderating the relationships between internal processes, external network attributes and technological entrepreneurship capabilities, and in particular government policies and regulations, organizational culture and incentive system, chosen among other relevant factors for their relevance in both technological entrepreneurship and the Chinese context.
- (4) A number of other relevant factors such as (individual) entrepreneurial cognition (Alvarez and Busenitz, 2001; Venkatraman and Sarasvathy, 2001), export propensity (Zhang *et al.*, 2009), ownership and other factors argued as important in Chinese and received literature are being considered as control variables.

Technological entrepreneurship capabilities have been considered to have a mediating role between enterprises internal characteristics, external networks attribute and competitive advantage. This is in accordance with other frameworks that use internal capabilities as mediators and in particular the one of Zahra *et al.* (2006) and Wang *et al.* (2006).

The arrows indicate the relationship and the related propositions scrutinized. Some of the relationships hypothesized have been tested on Chinese sample, or in other settings, but most of them are referring to theoretical arguments or propositions that have not been found to be tested (at least in the Chinese context) or to hypothesis tested but resulted controversial. So, overall about 30 new propositions have been identified.

The propositions developed respond to a general research question as related to what are the internal and external factors influencing technological entrepreneurship capabilities of Chinese enterprises and, more specifically:

[...] whether and if so, how, to which extent and under what conditions specific: internal processes, external networks attributes, effects of formal and informal institutions, influence Chinese enterprises' technological entrepreneurship capabilities and their contribution to competitive advantage in a global environment?

Figure 4 shows a synthesis related of the main propositions identified as related to the general research question posited for each of the components of the research framework.

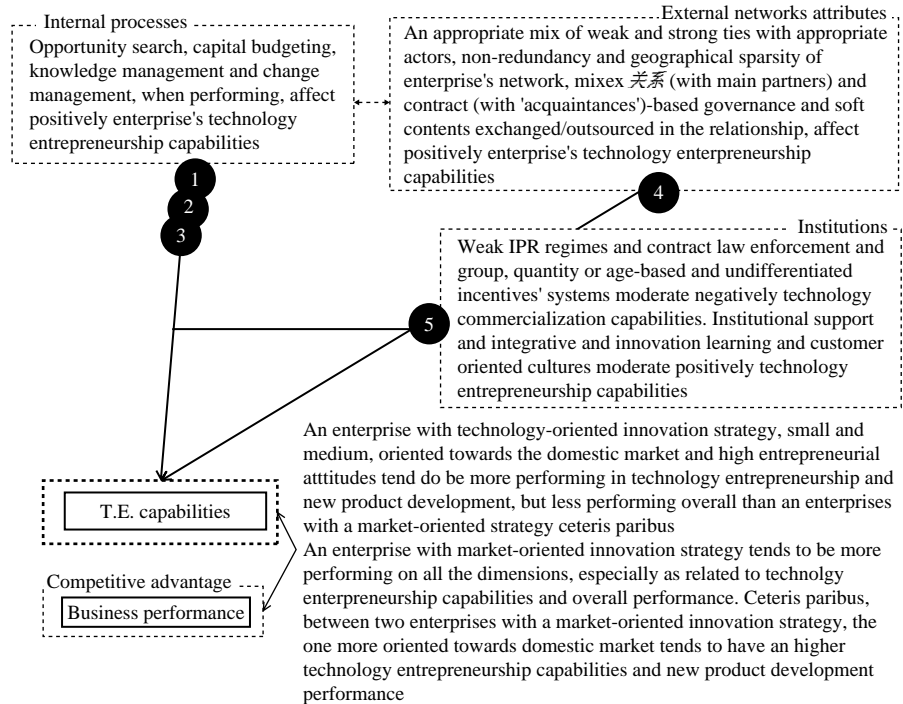


Figure 4. Factors enabling technological entrepreneurship in Chinese enterprises: propositions

Continuing using the map's metaphor, the integrated research framework developed is more to be considered as research map and a set of clues with three main uses:

- (1) Having an overview of the factors affecting technological entrepreneurship capabilities, with particular reference to Chinese firms.
- (2) Driving the development of research towards the definition of more specific research questions, model, testable hypothesis and related studies that build and add value to previous research.
- (3) Organize the body of knowledge scattered in different literature and context in building (and updating continuously) a state of the art of the research in technology entrepreneurship field, with particular focus on enterprises' technological entrepreneurship capabilities and their contribution to competitive advantage.

Conclusions and further research

All over this work, the authors contented that for Chinese's enterprises create a sustainable technology-based competitive advantage at home as well as abroad, will depend on the extent to which they will be able to identify and exploit technological opportunities to create new or significantly improved products and to successfully commercialize them, referred as technological entrepreneurship capabilities.

For this purpose, relying on a broad multi-disciplinary literature review that surveyed about 100 studies among academic studies and policy documents and reports,

a number of internal and external factors that influence or might influence those capabilities have been identified. Those factors have been organized into an integrated research framework and a number of theoretical propositions that constitute a guide for research related to the influence of specific enterprise's process, external networks attributes and the effects of formal and informal institutions on Chinese enterprises technological entrepreneurship capabilities and their contributions to competitive advantage.

The framework developed has the potential to give more comprehensive explications of the phenomena under scrutiny, but at the same time cannot explain in details all the possible relationships between its components as a number of separate studies on single components. To overcome these limitations, two different directions are now being pursued. The first is to use this framework to point at phenomena currently understudied and reduce the number of propositions to the essentials, without altering the structure of the framework. The other is to draw more specific research questions and conduct a number of related studies as related to single components. In both cases, it is our opinion that multiple-fields studies should be undertaken. This opens a number of opportunities of further research questions and directions emerged during its realization such as:

- (1) Deepening the study of single components including other factors, for example other moderating institutions, such as specific incentives such as tax incentives and public procurement or programs such as the Torch Program, the role of national entrepreneurial culture or the education system.
- (2) Studying how the internal components interact among them in influencing technological entrepreneurship capabilities, for example the interplay of knowledge management process with opportunity search and capital budgeting ones (i.e. between absorptive capacity and entrepreneurial orientation).
- (3) Developing sub-models aimed at studying the relationships and influence of more specific components, for example between foreign direct investment (FDI), technological entrepreneurship capabilities and overall performance moderated by absorptive capacity or the relationship between external networks attributes, technological entrepreneurship capabilities and competitive advantage mediated by environmental factors and absorptive capacity.

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