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# What Drives Technology Innovation Among The Emerging Chinese Enterprises?

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# WHAT DRIVES TECHNOLOGY INNOVATION AMONG THE EMERGING CHINESE ENTERPRISES?

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## Abstract

*In the light of rapid development of technology/knowledge intensive firms arising from the emerging economy of China in recent time, this paper is aimed at developing an analytical framework, based on the institutional theory and resource-based view, to evaluate the drivers and antecedents of technology innovation among Chinese emerging multinational enterprises (MNEs). Use of case study approach, the study examined two large Chinese enterprises in Wuhan and found that a linear sequential pattern of technology innovation did not apply. In contrast, two enterprises investigated tended to combine several types of innovation (strategic cost, organisational and operational innovation) to manage their internal capabilities and other organisational activities and routines to change, learn, adapt and create technology innovation. Our finding in this study also suggests that the key factor for Chinese firms to be innovative is more internally driven by several human resource management strategies that helped build technological capabilities effectively. Main implications of this study are that organisational human resource managers, technology and system designers should work together to design and develop enterprise management systems conducive to enhance both technology and human creativity for emerging Chinese multinational enterprises.*

*Keywords: technology innovation, capabilities, HRM, Chinese enterprises, emerging firms*

# 1 INTRODUCTION

In recent years, there have been a significant number of technology-intensive firms owned by mainland China (ie. Huawei, Lenovo, Haier, ZTE) appearing in the international scene. These firms have not only operated quite successfully at their home front, competing with those giant multinational companies inside China, they are also fast moving offshore, penetrating into the market previously dominated by the established multinational companies largely from the western world (UNCTAD 2008). This phenomenon of growing multinational companies from the emerging economies has caused many to wonder what drives the successful technology innovation among the emerging multinational enterprises (Fu et al. 2010).

The critical path to a successful industrial innovation is often understood to be both internally and externally driven, which is also arguably to be in a series of sequential steps (Dunphy et al. 1996). Unless these steps are undertaken, innovation would not likely to be in place. According to Dunphy et al. (1996), technology innovation at the firm level occurs when there is, first, a scientific discovery from anywhere in the world; then this new idea (or discovery) leads to an invention or application of new technology in the form of a product or a process by an individual or an organisation; lastly the invention (or product) is being commercialised or the idea (the process) is being adopted by the community of practice. Examining these steps of technology innovation in the context of emerging Chinese firms, it is nonetheless unclear whether Chinese firms have necessarily gone through these steps sequentially. Furthermore, internal and external forces that have driven Chinese firms' technological innovation have not been examined in the extant literature.

Mathews (2006) in his study of dragon multinationals argues that technology innovation for some East Asian companies is not just about use of high-tech, but involves a *dynamic process* which takes into account many elements such as strategic management of various resources, activities and routines around and inside the organisational internal and external environments. It is for this reason that the current paper is positioned to first develop a research framework to analyse the internal and external factors that could have effected on firms' technology innovation capabilities and performance in the context of Chinese firms. Second, given the new development of emerging multinational firms from China, it is believed that their technology innovation might not go through the linear sequential steps as suggested by Dunphy et al. (1996). In contrast, the dynamic process involving leapfrogging, learning and leveraging of global value chain (ie. existing multinational companies' diffusion of technology and management know-how) in advancing technology could be more likely taken place among these emerging firms (Mathews 2006; Luo & Tung 2007; Fu et al. 2010). Our aim is to identify these latent paths to technology innovation, which could have implications to further extend our understanding of interactive relationships among individuals, organisations and external environment in the process of adoption, use, and effects of technology at the firm level.

The rest of the paper is organised as follows. The literature review section provides two theoretical justifications on the drivers of technology innovation and discusses innovation-related activities at the firm level that could have boosted technology advancement in the context of Chinese firms. Intertwined with these discussions, empirical studies of technology innovation in China together with contextual issues are analysed. Research propositions are correspondingly developed. Research methods, with particular reference to the profile of two Chinese case companies are explained. Discussion of the results is presented. It is believed that the interplay of internal and external influences has formed a strong force to push Chinese firms to be technologically innovative in the past decades. Main outcomes of this study have implications to better design organisational systems conducive to enhance both technology and human creativity. Conclusion points to both policy and practical implications in the area of technology innovation among the emerging Chinese multinational firms.

## 2 LITERATURE REVIEW

It is essential to understand that certain prerequisites must be first met prior to any technology innovation taking place at firm level. Dunphy et al. (1996) used an innovation funnel to illustrate these prerequisites, which include global technological development stage; national level of technology infrastructure and industry mix; and firm level of characteristics such as organisational size, structure and strategy (also see Ramanujam & Mensch 1985; Durmusoglu et al. 2008; Fu et al. 2010). It is assumed that technology innovation for the emerging Chinese firms is also influenced externally by global value chain of technology development and diffusion, and by the Chinese government's emphasis on building information technology infrastructure and on high-tech industries at the national level, especially since the economic reform started in the late 1970s. Prior empirical studies tend to focus on assessing the interaction between global technology development and China's national innovation systems (eg. Hu & Mathews 2008; Fu et al. 2010). Less research looks into the interaction between these external environment and internal factors influencing Chinese firms to be technologically innovative. In this section, our intention is to review two main theories informing us of the reasons why firms want to be innovative broadly. We also explore at the organisational level, key factors that would boost technology innovation in the context of China. We develop a research framework based on these two streams of literature review.

### 2.1 Theories explaining the drivers of innovation

The existing literature provides two theories to explain the drivers for innovation at the firm level. These are the institutional theory and resource-based view (RBV).

#### 2.1.1 *The institutional theory*

According to *the institutional theory*, firm's innovative behaviour and strategic choices are driven primarily by isomorphic pressures embedded in formal and informal institutions (DiMaggio & Powell 1983). A firm is motivated to enhance its legitimacy by either doing things dramatically different ('innovative' but economically, politically and socially acceptable) or conforming to others ('imitative' in the environment through isomorphism process such as coercive, mimetic and normative mechanisms) (see detailed discussion in DiMaggio & Powell 1983; Zhou & Li 2007; Yang 2009). Briefly, coercive isomorphism refers to a firm's response to political or legal authorities; mimetic isomorphism derives from uncertainties surrounding changes in technology and environment that force the firm to model itself on others, especially those successful firms; and normative isomorphism causes the firm to follow the norms and values defined to be socially and economically acceptable (DiMaggio & Powell 1983).

In the context of Chinese firms, the state advocacy for enterprise modernisation since the economic reform and its drive to build national innovative capacity by focusing on key industries such as information technology, automobile and biotechnology etc (see Hu & Mathews 2008; Lu & Etzkowitz 2008) has greatly induced coercive forces at the firm level, pushing leading firms to be technologically innovative. Under uncertain environment and weak institutional framework (eg. lack of legal enforcement on patent protection), it is safer for firms to mimic or model their own behaviour and practices on the leading firms, especially in the areas of technology upgrade and adoption of management know-how. For example, Deng (2009) discusses a number of formal institutional constraints such as inefficient legal framework, and weak intellectual property rights which discourage innovations, making businesses hard to invest in R&D or to build global brands. As a result, Chinese firms tend to acquire strategic assets by expanding overseas because the internal development of technology capabilities is time consuming and path-dependent upon the firms' existing resources. Deng (2009, p. 77) hence asserted that Chinese firms rarely create new products

and process; they typically compete on volume and low price, and often simply imitate each other's products.

Without clear rules of the game, the imitation is the best strategy Chinese firms can adopt to survive at least for the short term, if not aiming at the long term gains. We see here the mimetic isomorphism best explains the imitative behaviour – or a typical learning-foreign-technology-by-doing approach – taken by majority of Chinese firms in their early stage of technology development when they are facing greater uncertainty in the transitional environment (eg. changing regulations by the state and increasing emphasis on patent protection). However, when firms become gradually established and are familiar with the rules in the competitive environment, the likelihood of breaking rules and creating the indigenous innovation is possible (see Fu et al. 2010).

Lastly, norms and values are socially acceptable standards, which refer to how things should be done in a certain context. Even though the Chinese government takes itself as a socialist state, during the 30-odd year long economic reform period, it has in fact transformed the country into a market-driven economy, which emphasises competition and efficiency. With support of the central government's industry innovation policy, social and economic values of Chinese firms have developed to focus on technology innovation in order to achieve the enterprise goals in the context of ever increasingly competitive market.

However, one needs to be very careful when examining the technologically innovative activities of Chinese firms, not simply by what they said but what they actually have done. As illustrated by Chen and Kenney (2007), the Chinese definition of 'high technology' or 'innovation' is very broad and only some of the activities would conform to the commonly accepted definitions of technology innovation in developed countries. They gave an example of 'personal computer assembly' to be considered as one of innovative and high-tech activities, whilst few in Europe or US would see it as such. Most importantly, Chinese firms would gain tax and other benefits if they are considered to be technologically innovative, according to the government's policy guidelines. This vested interests push Chinese firms to present themselves (in some ways, disguise) as innovative, following the norms and values (especially those valued by the funding bodies or administrative agencies controlled by the communist party) so they could gain the government support in R&D funding and tax avoidance.

Norms and values work together with coercive forces in China. There is no doubt that Chinese government plays an important role in instilling innovative values and indirectly influencing the direction of firm R&D investment decisions through taxation and loan schemes. According to Lu (2000), the government targets in certain industries and devises sophisticated tax concession schemes to promote technology innovations in products and processes at firm level. The uniqueness of this operation of re-distributive devices is the regulatory regime imposed upon firms by rhetoric reaction, such as granting high-tech innovative firms with a special legal status (Lu 2000). Then the government would oblige them to meet certain requirements, which include specifying the number of technology personnel, the percentage of sales contributed by new products etc. Therefore, it appears that the institutional devices and the corresponding regulatory regimes (Lu 2000) have generated incentives and encouraged firms to pursue technologically innovative activities as necessary legitimacy, but not essential to achieve real technology innovation, with commercialised aim as described by Dunphy et al. (1996).

Based on the above discussion, it appears that technology innovation among Chinese firms is likely to be influenced by several institutional factors such as state advocacy for technology advancement and policy support; industry pressure to conform by using similar technology at firm level (eg. manufacturing process required by foreign joint ventured partners); improved socio-economic and education conditions for the past 30 years in China as well as global technology environment, which facilitate the diffusion of advanced technology to indigenous Chinese firms (see Figure 1). Hence, the first proposition for this study is:

P1: Based on the institutional theory, technology innovation among Chinese firms is likely to be driven by several external factors.

Specific factors pulling Chinese firms to be technologically innovative should be identified using an exploratory approach via case study that is adopted in this study. It is also believed that push factors are in play for Chinese firms to be innovative, and these push factors are internally driven, largely generated from business strategy at the unit level (Rmanujam & Mensch 1985), embedded in the idea of resource-based view explained next.

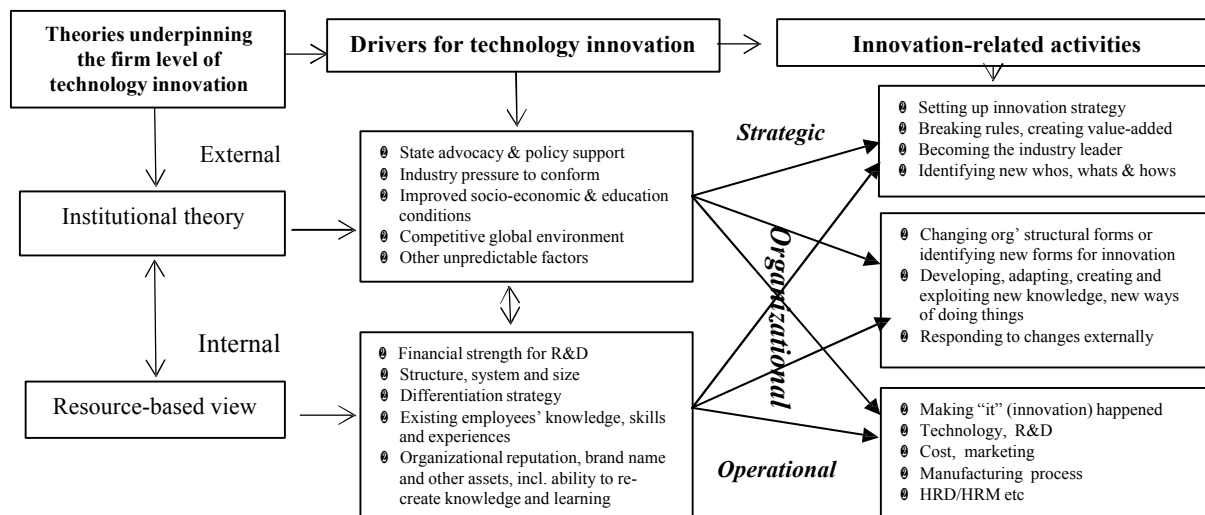


Figure 1. Driving forces for technology innovation among emerging Chinese firms

2.1.2 Resource-based view

Besides institutional factors, the potential driver for firms to be technologically innovative is likely to be determined by organisational internal structure, culture and resources. Despite pull factors caused externally, there might be push factors generated internally by firms for gaining strategic competitive advantage. The **resource-based view** provides theoretical explanations on this aspect, arguing for building internal innovative capabilities essential to achieve high performance outcomes in order to fulfil the firms' strategic positioning in the competitive environment.

Barney (1991) argues that a competitive advantage of a firm lies in its abilities to allocate and deploy the bundle of valuable resources, which must be heterogeneous in nature and not perfectly mobile (p. 105). Central to the resource-based view (RBV) are that firms' strategic resources must be 1) valuable in terms of its ability to add value which outperforms its competitors; 2) rare in terms of its ability to generate future above-average return; 3) inimitable in terms of its ability to create tacit knowledge and socially complex work environment which cannot be copied by its competitors; and 4) non-substitutable in terms of its ability to continue creating new value that cannot be replaced.

Clearly, the application of RBV to technology innovation must address the fundamental questions of why a firm wants to be different or to adopt new technology or even to change dramatically; and how it deploys its unique internal resources to do so in order to achieve and sustain its competitive advantages. Here, firms' internal resources can be both tangible (eg. financial, physical) and intangible (eg. knowledge, experiences and skills of employees, firms' reputation, brand name and other organisational assets) (Barney 1991; Wernerfelt 1994) (see Figure 1). Technology innovation capabilities are arguably developed by a firm's capacity to deploy and coordinate these dynamic resources in combination and re-combination desirable to achieve the next level of innovation and

value-creation (Galunic & Rodan 1998). Competencies/capabilities generated from recombined resources are the antecedents necessary for technology innovation, in particular for knowledge-based innovation to occur (Dunphy et al. 1996).

It appears that dynamic interaction between resources, capabilities and strategic orientation are the antecedents for building an innovative system at the organisational level. Technology innovation does not only come from external forces, but likely from looking inside and developing the resource endowment, especially core human resource's competencies and capabilities. The latter are the ones who will offer, in continuous manner, input for the development/exploitation of the firms' technology innovation activities. So we see here that the RBV provides the explanation on the reason for firms to innovate (to maintain and sustain the competitive advantage) and on how to provide the fuel for innovative activities to occur in the first place (to build internal capabilities and competencies through investing in human resource development and management – HRD/HRM).

Two empirical researches looked into the innovative capabilities of Chinese firms based on the RBV. First, Yam et al. (2004) studied 213 firms in Beijing with focus on assessing their technological innovation capabilities. Seven technological capabilities such as R&D, resource allocation, learning, manufacturing, marketing, organising and strategic planning capabilities were specified without theoretical justification. Yam et al. (2004) measured innovation performance in line with the Chinese convention, which says that 'an innovative firm is one which has an innovation rate of greater than 20 percent in the last 3 years) (p. 1129) (Note: this rate was not clearly defined. Is it the rate of new product creation in the given year? We are unsure here). The conclusion drawn from Yam et al.'s study is that only 72 out of 213 firms (30 percent) could be categorised as innovative firms; and that only R&D capability could safeguard technology innovation rate among this cohort of Chinese firms. The second interesting study carried out by Liu et al. (2009) focused on the 10-year-long practice of mobilising key resources to build strategic capabilities to enhance technological innovation in a textile company in China. They found that the firm's technological-innovation-based strategic capabilities were broadly influenced by neither technological resources, nor innovation resources, but organisational culture, human resources and organisational structure, among which human resources is the most dynamic one (p. 411). Therefore, the second proposition for this research is:

*P2: Based on the resource-based view, technology innovation only occurs when Chinese firms build internal capabilities and competencies through investing in human resources.*

From the above discussion, both the institutional perspective and resource-based view provide explanation on why Chinese firms want to push for technological innovation. Yet very limited research was conducted to explore this. Furthermore, whilst theories explain the drivers of technology innovation, the process of technology innovation which might have engaged in a range of organisational activities, acting as antecedents for innovation was not clearly examined. In the following, a review of relevant literatures is conducted to especially explore three areas of innovations: strategic, organisational and operational innovation, which has been widely discussed recently with reference to the development of emerging multinational companies (eg. Kim & Mauborgne 2005; Mathews 2006; Anderson & Markides 2006; 2007; Williamson 2009).

## **2.2 Technology innovation-related activities at the organisational level**

With reference to innovation, the literature focuses on three areas: strategic, organisational and operational innovations, which have direct association with technology innovation. Each of these areas is reviewed below, with a particular focus on developing research propositions relevant to Chinese firms.

**Strategic innovation** is about breaking the rules and becoming industry revolutionaries, also phrased as ‘value innovation’ aimed at finding ‘new whos’ (new customers), ‘new whats’ (new products or services) or ‘new hows’ (that is new ways of promoting, producing or distributing) via technology innovation aligned with ‘utility, price and cost position’ (Markides 1997; Kim & Mauborgne 2005; Anderson & Markides 2007). Anecdotal evidence (see Anderson & Markides 2006; 2007; Williamson 2009) suggest that companies from emerging economies such as China are particularly good at using the blue-ocean strategy by moving away from the red and bloody waters (saturated markets with big giants of established multinationals). Chinese firms tend to launch into new territories - the niche markets by offering customers with exceptional utility, affordable products and services, nonetheless earning considerable profits via strategic costing model. Systematic study of the strategic innovation among Chinese firms is yet to be explored. Patchy empirical studies (eg. Zhou et al. 2005; Zhou 2006) concluded that an imitation strategy, not innovation, remains as a viable and common strategy among Chinese firms. In addition, the studies by Anderson and Markides (2007) and Williamson (2009) show the evidence that strategic cost innovation has been employed by many Chinese firms. Therefore a relevant research proposition could be considered as:

*P3: Chinese firms are more likely to have used a strategic cost-cutting approach to technology innovation than to have focused on new product innovation.*

**Organisational innovation** refers to the creation or adoption of an idea or behaviour new to the organisation (Lam 2004). Firms may imitate the idea or behaviour exhibited in their competitors, but they are new to the organisation, hence regarded as innovative (Garcia-Morales et al. 2006). Many theoretical explanations to achieve organisational innovation (see Lam 2004), but three theories, which closely associate with the organisational human resource management and development mechanisms, deserve a brief review here.

First, organisational design theories emphasise changing organisational structural forms in order to do something new or apply new technology. Under these theoretical guidelines, the unit of analysis is the organisation and the main aim is to identify the structural characteristics of an innovative organisation, or to determine the effects of organisational structural variables on product and process innovation. Second, organisational cognition and learning theories tend to focus on the micro-level process and examine how organisations develop and adapt new ideas for problem solving. The focus is on the cognitive foundations of organisational innovation and on understanding the capacity of organisations to create and exploit new knowledge and skills necessary for technology innovation activities. In assessing multinational companies from China, many attribute to the success of these companies in the international markets to their keenness, leapfrogging or springboard approach to fast learn and develop new ways of doing things, which have to do not so much just with technology, but with management and organisational know-how (Buckley et al. 2007; Luo & Tung 2007). The third perspective is based on organisational change theories. In some ways, these theories are related to the first one, but emphasise on the processes underlying the creation of new organisational forms in the context of internal and external environments. The main focus is to understand whether organisations can overcome inertia and adapt in the face of radical environmental shifts, and whether organisations have capacities to respond to changes in the external environment, and to influence and shape it (Lam 2004). Human resource management and development systems are aimed at facilitating the design of new jobs as a result of new organisational forms; creating organisational learning and development environments so as to generate new knowledge and skills for innovation; and directly involving in managing the organisational change process (Kramar et al. 2011). Therefore, HRM is really the integral part of organisational innovation.

Since the economic reforms, and more so after the WTO accession, Chinese firms have been under enormous pressure to change and innovate as a result of the government economic policies and changing market conditions. To survive in the fierce market place, firms must respond to changes. The responses may well be exhibited in creating radical new organisational forms, such as town and



village enterprises, collective, joint-venture, private-owned, state-owned, foreign-owned, and more recently merged and acquired global networks, and in the forms of technological advancement (Yang 2009), as well as in adoption of innovative human resource management practices within firms (Zheng et al., 2009).

**Operational innovation** is about the improvement of current business model adopted by firms and the transformation of the organisational work processes by deploying new ways of performing tasks and implementing changes (Hammer 2005), again directly linked to human resource management. We simply call this process of innovation as ‘make it happen’! It is argued that when the business model is conducive to technology innovation, every area of business, such as marketing, production, human resources, accounting and finance should be working in an integrated system to exploit advances in technology to effectively support various stakeholders. One of the key enemies to make operational innovation work is the Voltaire's trap (Hammer 2005). The ‘trap’ aims at achieving perfect designs of an ultimate new way of doing things. This usually ends up doing nothing because of perfect solutions often being too grandiose to be implemented. Hammer (2005) suggests developing a technology solution that provides most but not all desired capabilities. The key is to ‘get into the field quickly’ and improve the process over time. Anecdotal evidence (see The Levin Institute Report 2006) indicates that Chinese firms exemplify in operational innovation, especially in the area of adapting to new business model, finding new ways of learning, working, operating, and delivering benefits of new technology.

One of the operational innovation for which Chinese firms are well-known is cost innovation. Cost innovation is somewhat similar to what was described earlier by Anderson and Markides (2007) as strategic innovation in the areas of affordability, acceptability and availability (4As), whereby consumers and customers are provided with exceptional utility, affordable products and services. Firms essentially use cost-reduction as a competitive advantage to achieve performance outcomes. Many Chinese companies, especially offshore ones, have tapped into both upstream and downstream markets with a mass market strategy (Zeng & Williamson 2007). They considerably reduce price, but still are able to sell products containing advanced technology and R&D inputs (see ZTE as an example). One needs to be mindful however, that cost innovation can only be achieved when two conditions are met: the existence of a global value chain to facilitate continuing technology acquisition and diffusion; and continuing downward pressure on global wages. It is believed that Chinese firms are able to deliver high technology at low cost because they are more able to tap into available sources of technology more cheaply than elsewhere (Lu 2000; Mathews 2006b; Fu et al. 2010; Williamson 2010). This is because of the government’s initiative of ‘market for technology’ and simultaneously foreign firms’ willingness to trade technology for market. Additionally, the supply of qualified local Chinese scientists and engineers is still steady and it looks like very unlikely, at least in the short term, that these personnel, without organised effort, will be able to negotiate higher wages. If, under any circumstances, these two conditions change, firms would have to focus on organisational HRM and technological innovation in order to find new ways to do more with less.

A systematic investigation of the-above mentioned innovation-related activities among Chinese firms is not available. Literature tends to focus on the outcomes of the organisational innovation in terms of capabilities, instead of assessing the organisational antecedents of technology innovation. Given the new development of Chinese firms, it is timely to test whether they are innovative at the organisational level by looking at the nature of the relationship from three different but interdependent perspectives as discussed earlier. Therefore, a set of propositions related to strategic and operational innovation at the organisational level are:

*P4a: Technology innovation among Chinese firms is related to changes in organisational structure, size and strategy*

*P4b: Technology innovation among Chinese firms is related to changes in effective organisational learning and knowledge creation;*

*P4c: Technology innovation among Chinese firms is related to organisational capacity for change and adaptation, especially to new business model; and*

*P4d: Technology innovation among Chinese firms is related to strategic cost innovation.*

### **2.3 Technology innovation and people management**

**Technological innovation** has mostly been discussed in the literature and described as the process through which new or improved technologies are developed and brought into use through the interaction among a number of organisational and contextual factors as discussed previously. Individual, organisational as well as contextual variables were found to be predictors of technological innovation (Kimberly & Evanisko 1981; Lam 2004). However often many previous innovation research have focused either on macro variables such as tax or social policies or on micro variables such as characteristics of innovation adopters, to the frequent exclusion of the organisational contexts and human resource management, in which the effects of these variables are played out (see Tornatzky & Fleischer 1990; Katz & James 2005).

It is widely recognised that one of key organisational variables impacting on technological innovation is people. Howell and Higgins (1990) describe five types of personnel in the firm's technological innovation process. First, the gatekeepers are the ones who acquire, translate, and distribute external technological knowledge and advancements to their colleagues. Second group are project champions who distil creative ideas from information sources and then enthusiastically promote them within the organisation. Third are business innovators providing support, access to resources, and protection from organisational interference as technology innovation emerges. Four ones are those technical designers and developers. Lastly, the user champions are those implementing technology innovations by training and providing assistance to the users (Howell & Higgins 1990, p. 318).

For a firm to be technologically innovative, a clear identification of these champions (i.e. key talents) and provision of human resource management and development mechanisms to not only encourage human creativity but also promote interaction of the champions from inside and outside is crucial (Scarborough 2003; Katz & James 2005), because these interactions enhance technology diffusion and global brain circulation. Altenburg et al. (2008) explicitly define the innovation champions in modern Chinese and Indian firms as those highly mobile technically skilled engineers, scientists and entrepreneurs travelling between leading and late-comer countries, creating backward and forward linkages and promoting technology transfer and diffusion. It is believed that Chinese firms, so as those emerging firms from BRICS (Brazil, Russia, India, China and South Africa) tend to utilise this 'brain circulation' of entrepreneurs, scientists and engineers to quickly build up technological innovation capabilities at the firm level (Altenburg et al. 2008; Fu et al. 2010). Furthermore, Li et al. (2006) in their relatively large scale of empirical investigation on human resource, technology innovation and firm performance confirm that there are the interrelationships among several human resource functions and technologically innovative performance outcomes. However, the drawback of Li et al.'s (2006) study is that it did not emphasise on technological capabilities generated from human resource management and development systems, which is the focus of current research. Therefore, our last research proposition for this study is:

*P5: Technology innovation among Chinese firms is associated with good human resource management and development systems which enable building necessary technological capabilities.*

To test the above-mentioned five research propositions, we conduct interviews into two technology-based firms in China during the period of September-October, 2010.

### **3 RESEARCH METHOD**

As the field of technology innovation among Chinese firms is quite complex, containing a significant number of inconsistency in research outcomes, we decided to conduct an in-depth interview to test out the research propositions presented previously. Two technology/knowledge-based Chinese firms in Wuhan were selected as the cases for analysis. For anonymous reason, two firms are labelled as TIE1 and TIE2 (TIE = technologically innovative enterprise). Four interviewees (Director of General Manager's office and Manager for Organisational Strategy from TIE1; the Owner/Founder's wife and Assistant General Manager from TIE2) hold reasonable high positions in the firm, with substantial knowledge about their firms' strategy, organisational structure and culture, technology innovation and development trends.

TIE1 is a privately owned Chinese company, established in 1993, currently listed on the Shenzhen Stock Exchange. The company, employing over 5000 people, has the core business on using bio-fuel to generate electric power. They also work on developing new energy for chemical industry, and new products for environmental protection and water treatment.

TIE2 is a collectively Chinese owned company with one state agency owning 40 percent of its shares. It was established in 1999, to be listed in the Shanghai Stock Exchange. Employing over 700 people, the company focuses on security data management, producing various cards/chips used for communication (eg. mobile phone), banking (eg. credit cards), and transport (eg. e-travel cards). Currently the company has business operations in over 20 countries, mainly spreading around countries in the Middle East and Africa region.

Standard questions were asked in Mandarin and translated back to English by the first author who is fluent in both English and Mandarin. Questions asked are largely related to the drivers and contents of innovation activities as previously discussed in the literature review section. Transcription was taken in English and Chinese. The eyeballing approach was used for content analysis, after cross-checking the translation and words meanings in the conversation between the interviewers and interviewees. Direct quotes from the interviewees would not be appropriate because of the translation, hence not used in this study but meanings of what they responded to certain questions are presented. Three themes emerge to address the drivers and activities of technology innovation and effects of human resource management on development of technology capabilities among emerging Chinese firms.

## **4 RESULTS**

### **4.1 Drivers of technology innovation**

Interestingly, both firms indicated that their aim for technology innovation was definitely more internally driven (ie. resource-based view for strategic reasoning). This is mainly due to the fierce competition both in domestic and international markets. As privately or collectively owned companies, both expressed that survival is their companies' main goal. To survive in the current market condition, firms must do something new internally every year to be different from their competitors in order to report back to their shareholders as both firms are listed in the stock exchange. This result appears supporting the research proposition 2 (P2).

Building the internal innovative capabilities and core competencies is indeed challenging. It involves an integrated strategy that facilitates the operationalisation of organisational entrepreneurship, technological capabilities, and financial resources invested during the technology development period (Lee et al. 2001). In particular, core competencies must be developed through ‘collective learning, coordination of diverse production skills and integration of multiple streams of technologies’; they cover ‘many levels of people and all functions’ (Prahalad & Hamel 1990, p. 82). Effective development of internal capabilities and core competencies is the heart of human resource management strategies largely embedded in the resource-based view (Wright et al. 2001). In the current study, both firms reported to have adopted some human resource management strategies (discussed in more details later) in enhancing firm technology capabilities.

The results in this study, nonetheless, do not strongly support the research proposition 1 (P1), whereby it states that technology innovation among Chinese firms is likely to be driven by external factors. Although the author (interviewer) pointed to several institutional factors indicated in Figure 1 during the conversation, both TIE1 and TIE2 responded that these factors did not actually help firms’ technology advancement. With regard to the government role in patent protection, both respondents were rather adamant about the patent protection under the China’s Patent Law. Yet both agreed that the destiny of patent protection of the firms’ inventions must be taken in the hands of firms themselves, not relying on the government intervention. For example, TIE1 described a 3-year long court case between the company and its counterpart (the organisation can’t be named for anonymity reason) because of dispute of ownership of TIE1’s initial patent (ie. type of water management technology by using particular chemical to clean water). TIE1 had not only failed miserably in the court case, but also led to hundreds of small firms who followed the court case and became wealthy after learning and using their water management technology (a ‘triumphant’ technology imitation case by Chinese smaller firms, according to the interviewee from TIE1).

There was a conflicting response given by TIE2, the government policy support was nonetheless acknowledged. Yet, it is unsure whether Assistant General Manager was obliged to provide the positive feedback to this question when asked, because TIE2 is now a collectively private-owned firm with 40 percent stake held by one of the state agents. The response became clearer when asked about the funding source for R&D, the answer was definitely self-funded, not relying on the government loans or any external bodies except those capitals generated from the stock exchanges.

These results suggest that emerging Chinese firms rely more on building internal capabilities and core competencies conducive to technology innovation than on external support, even though fierce competition externally (incl. China as part of the emerging global markets) does reinforce the necessity to build differentiated strategies to compete successfully in the global market.

#### **4.2 Technology innovation-related activities at firm level**

When assessing the *strategic innovation*, both firms show the pride of using low cost strategy to beat their Western counterparts, especially in the domestic competition (Note: 95 percent of Fortune Global 500 firms currently present in China). This partially supports P3, as two firms also exhibited certain elements of invention (product innovation) via patent registrations inside China. For example, TIE1 reported to have had over 100 patents already registered in China (none in the USA because of strident patent application procedures), 54 product inventions registered but a few dozen of patents and inventions unregistered because of the fear of piracy swiftly after registration of patents and inventions inside China; this implies implicitly possible of official leaking of patent information.

Largely strategic costing strategy is adopted by the interviewed Chinese firms. For example, the blue ocean strategy (launching into new territory of markets) (Kim & Mauborgne 2005) was used especially by TIE2. As the interviewee of TIE2 (Assistant General Manager) indicated, the firm was

more willing to go to the countries whereby Western counterparts did not want to go. In less than five years, TIE2 was able to increase their overseas sales by triple, passing one third line to almost reaching 40 percent of the total sales. This was also largely due to their success in lowering price, not necessarily new products to capture foreign markets especially in Kuwait, Iran and some parts of the African continent. It appears that the firm essentially used price-reduction as a competitive advantage to achieve performance outcomes.

In the areas of *organisational innovation*, there is evidence that both firms exhibit all three areas of organisational innovation: changes in organisational structural forms, learning and knowledge creation, and quick adaption to external changing environment, supporting the research propositions (P4a, P4b and P4c). For example, one of the interviewees (Manager for Organisational Strategy) of TIE1 especially emphasised three stages of transformation of the firm, and each stage was acutely accompanied with new thinking, new products and new growth of the firm. TIE2 transiting from a joint ventured firm to a collectively private-owned one in a short period of time also illustrates changing organisational structure, though the novelty of products was not clearly demonstrated. The re-group of the firm TIE2, especially backed up by a state agency, nonetheless, had helped capture larger market size in the country. TIE2 also transformed itself quickly in the 2000s to look outward and established many international branches across the Middle East and Africa, by selling cheaper products to take up market shares in the international scene.

There appears a certain degree of link between technology innovation and operational level of costing model used by TIE2, though this is not so quite apparent in TIE1. The result nonetheless partially supports the research proposition (P4d).

### **4.3 Building technology capabilities via HR management and development systems**

In the area of human resource (HR) management and development, both firms investigated appear emphasising on building an integrated people management system that could help enhance technology capabilities internally. For example, both firms reported having over 50 percent staff in their core departments of research and development (R&D). This is a strong indicator of internal learning and new knowledge creation within. In particular, the Director of GM Office from TIE1 said that the success of their firm innovation depends largely on technological capabilities developed internally. TIE2 also emphasise the high proportion of profit margin re-invested in R&D and recruitment of quality human capitals even from abroad, boosting its technology innovation outcomes.

With reference to talent recruitment, interestingly, both firms in Wuhan, not located in the prominent geographical positions such as Beijing and Shanghai, have been competing to get talents from major top universities in these two cities. TIE1 even provides handsome compensation packages to recruit high profile R&D personnel around the world (ie. scientists from India and Russia). For instance, TIE1 provides decent allowances for those recruited offshore, with consideration of their family members, who need special accommodation and children schooling.

To build innovative capabilities within, both firms provide staff with incentives if they have innovative ideas, in particular inventions. Both firms are reported to have differentiated rewards to different types of patents (the highest reward is the one registered in the USA – interesting though, not yet one patent registered because of the strident application process in the USA). Nonetheless, TIE2 would give bonus to those achieving innovative performance outcomes at the end of year. Attempt to retain R&D personnel, TIE2 also provide tuition fees for those with 3-year service in the firm to attend further education and training. The interview results indicated that both TIE1 and TIE2 emphasise on regular performance evaluation and feedback, often once a month to maintain, retain and improve innovative capabilities.

Although there is no clear indication on the specific types of technology personnel (see Howell & Higgins 1990) in two Chinese firms investigated, some evidence of having a few human resource management and development functions to attract and retain R&D talents and to build internal technology capabilities were reported by two firms investigated. The result partially supports the last proposition (P5), which suggest an interconnection between technology innovation and people factors. However, there is no obvious evidence of systemic HR management and development systems in place to facilitate pipe-line development of human capitals for technological innovation in long run.

## 5 DISCUSSION & CONCLUSION

In the light of rapid development of technology/knowledge intensive firms rising from the emerging market such as China in recent time, this paper attempted to develop a basic analytical framework to evaluate the drivers and antecedents of technology innovation among Chinese emerging multinational firms. Indeed the results show a non-linear sequential pattern of technology innovation among Chinese firms. Often Chinese firms combined several types of innovation (strategic costing model, organisational and operational innovation) to strategically manage their 'resources, activities and routines' (Matthew 2006) to achieve innovation outcomes. In addition, against the conventional idea that Chinese firms were more inclined to be driven by the institutional factors (Peng & Heath 1996), our finding in this study suggests that the key factor for Chinese firms to be technologically innovative is more internally driven. But government policy support and industry competitive pressure from other multinational companies (MNCs) may have played some parts of influencing Chinese firms to be either innovative by doing something new or imitative by mimicking the behaviour of those established MNCs.

Firms' internal resources including technology champions, entrepreneurship, organisational structural change, learning and knowledge creation, as well as strong financial resources (ie. listing in stock markets to generate necessary capitals for growth) have contributed significantly to technology innovation among two Chinese firms investigated. This supports the resource-based view, which advocates that in time of fierce competition, firms must focus on differentiating their own internal capabilities and core competencies (Prahalad & Hamel 1990; Barney 1991) from their competitors in order to achieve the sustainable competitive advantage.

For developing the differentiated human capitals, there require systemic people development and management mechanisms, which would ensure ongoing generation of technology capabilities within firms. Current investigation of two Chinese firms has indentified only a few patchy practices of incentive pay, training and performance evaluation to encourage technology innovation. The fact that no HR managers responded to our request for interview perhaps indicates both lack of emphasis on human resources and associated enterprise systems to develop technology capabilities within.

Several implications for policy and practice can be concluded here. First, it appears from our study outcomes that support to generate firm level of differentiated capabilities and core competencies is more important than other types of policy support such as tax and R&D funding, which has often been misused in the China context (Lu 2000; Chen & Kenney 2007). Chinese firms generally found it hard to recruit and retain talents. Therefore, the central government funding to help higher education sector to raise a large pool of talents in science and technology would be far more effective in supporting innovation at the firm level than company tax incentive schemes. Second, our results point to the need to further invest in human capitals to develop internal technology capabilities. A systemic link between technology innovation, workflow and HRM is yet to be found in literature. Research in this area is also week. A platform might be required to bring together both organisational HR managers and system designers to find ways in developing and building enterprise management systems that are capable of attracting and retaining quality human capitals who could help generate further technology innovation among emerging firms.

## References

- Altenburg, T., Schmitz, H. & Stamm, A. (2008). Breakthrough? China's and India's transition from production to innovation. *World Development* 36(2), 325-344.
- Anderson, J. & Markides, C. (2006). Creativity is not enough: ICT enabled strategic innovation. *European Journal of Innovation Management* 9(2), 129-148.
- Anderson, J. & Markides, C. (2007). Strategic innovation at the base of pyramid. *MIT Sloan Management Review* 49(1), 83-88.
- Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management* 17(1), 99-120.
- Buckley, P.J., Clegg, L.J., Cross, A.R., Liu, X., Voss, H. & Zheng, P. (2007). The determinants of Chinese outward foreign direct investment. *Journal of International Business Studies* 38, 499-518.
- Chen, K. & Kenney, M. (2007). Universities/research institutes and regional innovation systems: the case of Beijing and Shenzhen. *World Development* 35(6), 1056-1074.
- Deng, P. (2009). Why do Chinese firms tend to acquire strategic assets in international expansion? *Journal of World Business*, 44, 74-84.
- DiMaggio, P. & Powell, W. (1983). The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *American Sociological Review* 48(2), 147-160.
- Dunphy, S.M., Herbig, P.R. & Howes, M.E. (1996). The innovation funnel. *Technological Forecasting and Social Change*, 53, 279-292.
- Durmusoglu, S. S., McNally, R. C., Calantone, R. J., & Harmancioglu, N. (2008). How elephants learn the new dance when headquarters changes the music: Three case studies on innovation strategy change. *Journal of Product Innovation Management*, 25(4), 386-403.
- Fu, X. L., Pietrobelli, C., & Soete, L. (2010). The role of foreign technology and indigenous innovation in emerging economies: Technological change and catching up. *Technical Notes*, No. IDB-TN-166. Inter-American Development Bank, Washington DC. pp.1-27.
- Galunic, D.C. & Rodan, S. (1998). Resource recombinations in the firm: knowledge structures and the potential for Schumpeterian innovation. *Strategic Management Journal* 19(12): 1193-1201.
- Garcia-Morales, V.J., Llorens-Montes, F.J. & Verdu-Jover, A.J. (2006). Antecedents and consequences of organizational innovation and organizational learning in entrepreneurship. *Industrial Management & Data Systems* 106(1), 21-42.
- Hammer, M. (2005). Making operational innovation work, *Harvard Management Update*, 10 (4), 1-7.
- Howell, J.M. & Higgins, C.A. (1990). Champions of technological innovation. *Administrative Science Quarterly* 35(2), 317-341.
- Hu, M.C. & Mathews, J.A. (2008). China's national innovative capacity. *Research Policy* 37(9), 1465-1479.
- Katz, R. & James, W.M. (2005). HRM and innovation, in Ronald J. Burke and Cary L. Cooper, eds. *Reinventing Human Resource Management: Challenges and New Directions*, New York: Routledge, pp. 259-274.
- Kim, W.C. & Mauborgne, R. (2005). *Blue Ocean Strategy: How To Create Uncontested Market Space and Make The Competition Irrelevant?* Boston: Harvard Business School Press.
- Kramar, R., Bartram, T., De Cieri, H., Noe, R.A., Hollenbeck, J.R., Gerhart, B. & Wright, P.M. (2011). *Human Resource Management in Australia: Strategy, People, Performance*, 4th edn, The McGraw-Hill Companies, Sydney.
- Lam, A. (2004). Chapter 5: Organizational innovation. pp. 115-147, in J. Fagerberg, D. Mowery, & R. Nelson (Eds.), *The Oxford Handbook of Innovation*, London: Oxford University Press.
- Lee, C., Lee, K., & Pennings, J. M. (2001). Internal capabilities, external networks, and performance: a study on technology-based ventures. *Strategic Management Journal*, 22(6-7), 615-640.
- Li, Y., Zhao, Y.B., & Liu, Y. (2006). The relationship between HRM, technology innovation and performance in China. *International Journal of Manpower*, 27 (7), 679 – 697.

- Liu S. J. (2010). China has a long way to go. *China Daily/European Weekly* 10 December, accessed on 3 March, [http://europe.chinadaily.com.cn/opinion/2010-12/10/content\\_11683287.htm](http://europe.chinadaily.com.cn/opinion/2010-12/10/content_11683287.htm)
- Liu, J., Baskaran, A. & Li, S. (2009). Building technological-innovation-based strategic capabilities at firm level in China: a dynamic resource-based-view case study. *Industry & Innovation* 16(4), 411 - 434.
- Lu, L. & Etzkowitz, H. (2008). Strategic challenges for creating knowledge-based innovation in China: Transforming triple helix university-government-industry relations. *Journal of Technology Management in China* 3(1), 5-11.
- Lu, Q.W. (2000). *China's Leap Into the Information Age: Innovation and Organization in the Computer Industry*. New York: Oxford University Press.
- Luo, Y. & Tung, R.L. (2007). International expansion of emerging market enterprises: A springboard perspective. *Journal of International Business Studies* 38, 481-498.
- Mathews, J.A. (2006). Dragon multinationals: New players in 21st century globalization. *Asia Pacific Journal of Management*, 23, 5-27.
- Peng, M.W. & Heath, P.S. (1996). The growth of the firm in planned economies in transition: institutions, organizations, and strategic choice. *Academy of Management Review*, 21(2), 492-528.
- Prahalad, C.K. & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, May-June, 79-91.
- Ramanujam, V. & Mensch, G.O. (1985). Improving the strategy-innovation link. *Journal of Product Innovation Management*, 4, 213-223.
- Scarborough, H. 2003. Knowledge management, HRM and the innovation process. *International Journal of Manpower*, 24(5), 501 – 516.
- Tornatzky, L.G. & Fleischer, M. (1990). *The Processes of Technological Innovation: Review of Literature*. Lexington, MA: Lexington Books.
- Williamson, P.J. (2010). Cost innovation: preparing for a 'value-for-money' revolution. *Long Range Planning* 43, 343-353.
- Wright, P. M., Dunford, B. B., & Snell, S. A. (2001). Human resources and the resource based view of the firm. *Journal of Management*, 27(6), 701-721.
- Yam, R.C.M., Guan, J.C., Pun, K.F. & Tang, E.P.Y. (2004). An audit of technological innovation capabilities in Chinese firms: some empirical findings in Beijing, China. *Research Policy* 33, 1123-1140.
- Yang, M. (2009). Isomorphic or not? Examining cross-border mergers and acquisitions by Chinese firms, 1985-2006. *Chinese Management Studies* 3(1), 43-57.
- Zeng, M. & Williamson, P.J. (2007). *Dragons at Your Door: How Chinese Cost Innovation Is Disrupting Global Competition*. Boston: Harvard Business School Press.
- Zheng, C., O'Neill, G. and Morrison, M. (2009). Enhancing Chinese SME performance through innovative HRM practices. *Personnel Review*. 38(2), 175-194.
- Zhou, K. Z., & Li, C. B. (2007). How does strategic orientation matter in Chinese firms? *Asia Pacific Journal of Management*, 24, 447-466.
- Zhou, K.Z. 2006. Innovation, imitation, and new product performance: the case of China. *Industrial Marketing Management* 35: 394-402.
- Zhou, K.Z., Gao, G.Y., Yang, Z.L. & Zhou, N. (2005). Developing strategic orientation in China: antecedents and consequences of market and innovation orientations. *Journal of Business Research* 58, 1049-1058.