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### Innovation for sustainability: Antecedents for technological innovation in China

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# **Innovation for sustainability: Antecedents for technological innovation in China**

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## Innovation for sustainability: Antecedents for technological innovation in China

### **ABSTRACT**

China is one of the most important emerging markets and has a great potential to become the next economic superpower with its world second largest GDP and fast economic growth. Yet it remains unclear how sustainable its economy could be in the turbulent world economy. This research proposes that technological innovation can help sustain China's economic development and then examines China's unique cultural environment and institutional context that might affect Chinese companies in different ways in innovation. Propositions are developed to explore the potential impact of a variety of antecedent factors for technological innovation in China. The examination of the relationship between institutional constraints and technological innovation, along with the comparison of the effects of various factors on innovation will help explore the unique characteristics of Chinese culture and facilitates multinationals' entry into the Chinese market.

**Key words:** sustainability, innovation, China, culture, institutional environment

China is one of the most important emerging markets with its world second largest GDP and fast economic growth. Along with its three-decade transition to a market-oriented economy, China has undergone massive restructuring on its innovation system. In 2006, China further announced its “Guideline for the National Medium- and Long-term Science and Technology Development Programs (2006-2020)”, the focus of which is to emphasize the strategic role of innovation and to lay out strategic plans to booster China’s aspiration for an innovation center by 2020 (Ma, Lee, and Chen, 2009). This study is intended to explore technological innovation in China by examining the impact of cultural context and institutional factors on Chinese firms’ technological innovation, with the focus on what particular factors help improve firm performance and then on how cultural context moderates this relationship. In addition, while the Chinese government plays a crucial role to create innovative culture and to encourage the interaction between universities, research institutes, and Chinese companies in order to promote innovation capacity (Motohashi and Yun, 2007), there is still lack of research that specifically examines China’s unique cultural environment and institutional context that might affect Chinese companies in different ways in innovation. An examination of the relationship between strategic choice and institutional constraints in innovation and firm performance, along with the comparison of the effects of various factors on innovation will help China maintain its long-term economic development and exploring the unique characteristics of Chinese culture will also facilitates multinationals’ entry into the Chinese market.

## **CONCEPTUAL CONTEXT**

Nowadays with the fast changing technology, firms are constantly forced to catch up and respond to the demanding market in order to remain in the leader positions in their fields. Many

companies and nations have realized the importance of innovation and started to integrate it into corporate plans or government policies. Therefore the concept of innovation has been gaining significant attention from the research field over the past decade. Innovation is defined as an ongoing, collaborative process that requires breaking away from old habits, developing new approaches, and implementing them successfully (Chen, Liu & Tjosvold, 2005). A firm that is willing to constantly destroy and rebuild their core competencies in order to remain market leaders is also more likely to innovate (Siguaw, Simpson & Enz, 2006). Innovation has become an essential capability that all firms and even nations need to have in order to survive in this globalizing competitive economy. Without innovations, nations cannot move forward. Current research studies focused on the innovation at firm levels, but innovation at national level is underexplored. It is very important to study innovation at national level because a nation's innovation capabilities often affect its ability to provide an appropriate environment for firms to innovate (Fu & Mu, 2014; Xu, Chen & Guo, 1998). In addition, many nations are also lack of knowledgeable personnel to carry out effective innovation plans (Gu, Lundvall, Liu, Malerba & Serger, 2009; Hutschenreiter & Zhang, 2007). The reasons include that national level of research on innovation and its impact is harder to conduct. It is also most costly and takes a longer period to see the results.

China is currently the world's largest manufacturing and exporting country with a big labour force, but that was not enough for the ambitious Chinese government. After the economic reform, China has started to concern in its innovation capabilities and it is eager to become the next world leader in technology and innovation (Cao et al., 2006; Serger & Breidne, 2007). Innovation has become one of the biggest challenges for China as it moves from a developing country to developed country and from imitation to innovation. In 2006, China further

announced its “Guideline for the National Medium- and Long-term Science and Technology Development Programs (2006-2020)” (MLP), the focus of which is to emphasize the strategic role of innovation and to lay out strategic plans to booster China’s aspiration for an innovation center by 2020 (Ma, Lee, and Chen, 2009). Some of the more detailed ambitious goals in the MLP include, “China will invest 2.5% of its increasing gross domestic product in R&D by 2020; raise the contributions to economic growth from technological advance to more than 60%; limit its dependence on imported technology to no more than 30%; and to become the top five countries in the world in the number of invention patents granted to Chinese citizens, and for Chinese-authored scientific papers to become among the world’s most cited” (Cao et al., 2006). Another purpose of the MLP plan is to hopefully lightening up and eventually overcome China's demand for resources and social and environmental challenges (Serger & Breidne, 2007). Many research articles indicated that investment on innovation plays a critical role in both Foreign Direct Investment (FDI) and government funding (Fu & Mu, 2014; Gu et at., 2009; Hutschenreiter & Zhang, 2007; Turro, Urbano & Peris-Ortiz, 2014). However, in all current studies there is no clear evidence on how much FDI and government investment on innovation have actually contributed to the growth of China's GDP. There is also lack of research on the effectiveness of the MLP on China's innovation capabilities and economic growth at the current stage. Instead, many researchers only focused on forecasting the effects of MLP but with no follow up in depth investigations (Cao, Suttmeier & Simon, 2006; Gu et al., 2009; Hutschenreiter & Zhang, 2007). In this article we attempted to look at the relationships between organizational culture and innovation at firm level, institutional factors and innovation, and culture factors and innovation at national level with a specific focus on China.

## **ORGANIZATIONAL CULTURE AND INNOVATION**

Research has examined the relationship between innovation and organizational culture at firm level over the past years. Organizational culture is defined as the "core values, beliefs, and assumptions that are widely shared by members of an organization" (Dessler, Chhinzer & Cole, 2013). Contemporary studies have shown that organizational culture plays an important part on firms' innovation capabilities (Siguaw, Simpson & Enz, 2006; Wei, Liu & Herndon, 2011; Yam, Guan, Pun & Tang, 2004). Many studies have indicated a number of characteristics of an innovative firm tend to increase a firm's ability of innovation, including a flatter organizational structure (Wei et al., 2011), decentralization within the firm (Wei et al., 2011), empowering employees (Wei et al., 2011), employees' participation in management (Xu et al., 1998), diversity of managers (Chen et al., 2005), and a reward system for taking initiatives (Siguaw et al., 2006). Some research has indicated that supportive human resources management helps facilitate employees' entrepreneurial behaviour in firms (Siguaw et al., 2006; Wei et al., 2011). It makes sense that employees are more willing to bring up new ideas when they are free from punishments such as the chance of getting fired. Many studies have pointed out that one of the biggest obstacles for Chinese firms to innovate is the lack of high quality human capital (Hutschenreiter & Zhang, 2007; Xu et al., 1998).

As mentioned earlier, firms with a flatter organizational structure and developmental culture has a stronger effect of strategic human resources management due to the reason that employees have easier and more access to information sources for innovation (Wei et al., 2011). Open and easy access to information encourages innovation within firms (Open innovation, Siguaw et al., 2006). Intraorganizational knowledge transfer or sharing is often weak in Chinese firms; however, it has shown to foster cooperative among all functional areas within to work

towards innovation as a whole (Gu et al., 2009; Siguaw et al., 2006; Todtling, van Reine & Dorhofer, 2011). More decentralization and supportive corporate cultures are especially needed in the Chinese firms as firms are now looking for more efficiency and proactive employees (Wei et al., 2011). However, there is no finding on specific organization structure or framework to be a significant predictor of product innovation (Wei et al., 2011).

Innovation has become the basic building block for organizational excellence (Yam et al., 2004). However, not all firms possess the ability to innovate and those do possess the ability for innovations have demonstrated some key characteristics in innovative management. These included: good internal and external communication (free flow of communication upward, downward and horizontally) and treating innovation as a corporate wide task (Yam et al., 2004). The idea of free flow of communications is parallel with the previous finding, open and easy access to information, as we have discussed earlier (Siguaw et al., 2006; Todtling et al., 2011). Therefore this has shown the importance of mobility of knowledge within firms to its innovation capabilities (Gu et al., 2009; Siguaw et al., 2006; Todtling et al., 2011; Yam et al., 2004). Recent research has also identified that corporate culture or organizational culture overall has significant impact on firms' innovation abilities. Firms who possess entrepreneurial culture and view innovation as a corporate wide task are more successful at becoming innovative organizations (Turro et al., 2014; Wei et al., 2011; Yam et al., 2004). However, entrepreneurship is unfortunately a very scarce resource in China due to lack of education and training (Gu et al., 2009).

On the other hand, diversity sometimes can be view as an oppressor to innovation. However, research has proposed that the “diversity of managers' various thinking styles, and when properly used, it can stimulate innovation” (Chen et al., 2005). Culture diversity and

transfunctional acclimation facilitates knowledge transfer across and within firms to retain diversity of views which help stimulates innovation for firms (Siguaw et al., 2006; Todtling et al., 2011). Therefore we proposed that:

*Proposition 1: The greater the diversity in management style and labour force, the greater firms' innovation capabilities will be.*

In other words, firms who possess shorter chain of command, flatter organizational structure, free flow of information, developmental culture, integrate innovation in corporate vision and effective management are most likely to become an innovative firm (Siguaw et al., 2006; Wei et al., 2011, 2011, Yam et al., 2004). Even though this area is more focused at firm level and might not have direct impact on national level, it is still important to look at.

## **INSTITUTIONAL FACTORS AND INNOVATION**

Research has been conducted on the relationship between innovation and institutional factors and it is mostly focused on policies. Some institutional factors have been identified as important aspects of innovation, for example, openness to foreign trade and FDI (Hutschenreiter & Zhang, 2007), government support and funding (Fu & Mu, 2014; Gu et al., 2009; Hutschenreiter & Zhang, 2007), rules and regulations on innovation and patents (Turro et al., 2014), access to high quality human capital for R&D (Gu et al., 2009; Xu et al., 1998; Yam et al., 2004), strong Intellectual Property Right protection, and develop a system to finance innovation and commercialization of invention (Fu & Mu, 2014; Hutschenreiter & Zhang, 2007). These institutional factors can be improved by government's intervention through making appropriate

policies, therefore, it is important to find out what are the best policies that will incentivize firms while being actionable in China's unique political environment.

Because of the uniqueness of the Chinese culture and its political structure, it is important to examine the factors for innovation in China with a closer look. After more than 30 years of economic reform, China is moving from imitation to innovation. In 2006, China further announced its "Guideline for the National Medium- and Long-term Science and Technology Development Programs (2006-2020)", the focus of which is to emphasize the strategic role of innovation and to lay out strategic plans to booster China's aspiration for an innovation center by 2020 (Ma, Lee, and Chen, 2009). The Chinese government wants to build a national innovation system to help fasten the progress for China to become the world leader in technology and innovation (Cao et al., 2006; Gu et al., 2009; Serger & Breidne, 2007). The announcement has gained a lot of public interests and criticisms (Cao et al., 2006; Gu et al., 2009; Hutschenreiter & Zhang, 2007; Serger & Breidne, 2007), but little research has been done regarding the program's actual effectiveness. There was no article that clearly indicated of what happened over the past eight years for the firms who were under the plan or how much of GDP's growth was contributed by the MLP. It is questionable of whether the plan was effective overall and whether the national resources were being used wisely (Cao et al., 2006). Research has proposed that the MLP will have an impact on China's S&T but not necessarily innovation capabilities (Cao et al., 2006; Serger & Breidne, 2007). One of the reasons was that government funding does increase the quantity of R&D activities but does not always increase with quality (Cao et al., 2006). In the MLP, it mentioned that China is aiming to be a techno-nationalism which the objective is to reduce China's dependence on foreign technology to less than 30% and focus on home-grown technology (Cao et al., 2006; Serger & Breidne, 2007). Therefore other reason may be that, many

experts have argued that even though it is important for China to have "home grown" innovation in S&T, a country is unlikely to progress without the involvement in the globalization research and innovation. Other criticisms include biases, lack of transparency and efficiency in the program (Cao et al., 2006). Even though there are a lot of criticisms about the MLP program, most of these arguments are made at the early stage of the MLP. (Cao et al., 2006; Gu et al., 2009; Hutschenreiter & Zhang, 2007; Serger & Breidne, 2007) Because the plan was still at the beginning stage, it was hard to determine if the plan is actually ineffective at the point. There is no recent research on the effectiveness of the MLP as it go through middle stage and coming to the end of the plan. As we discussed earlier, government funding with a better national innovation system should increase national innovation's capabilities. Therefore it is logically that we proposed:

*Proposition 2a: Firms in China have shown improvement on innovation capabilities over the past years due to the implementation of the MLP program*

*Proposition 2b: MLP brought significant improvement in China's national innovation system and GDP has increased proportionately.*

Research has also identified some other factors that moderate the relationship between institutional factors and innovation. China's increasing openness to FDI played an important role in China's economic development and its R&D have been doubled in a decade (Hutschenreiter & Zhang, 2007). However, foreigners accounted for nearly 60% of invention patents granted in China in 2006. One of China's weaknesses is its adaptive capability, and it was evidenced that even with high knowledge spillover, China is still weak in "home grown innovation" or adoptive

capabilities (Gu et al., 2009; Hutschenreiter & Zhang, 2007; Yam et al., 2004). Therefore, the government has implemented the MLP to hope that this will be the solution as mentioned earlier. One of the challenges was that China has lack the market environment that encourages enterprise undertaking R&D and innovation. (Fu & Mu, 2014; Hutschenreiter & Zhang, 2007) Many managers focus on short-term goals, profits, instead of long-term growth (Hutschenreiter & Zhang, 2007). Therefore it is important for the government to not only enhance firms' innovation capabilities but also develop markets and educate consumers to gain greater market interests and demands. Some argued that it is debatable about the utility of stated-directed programs of innovation, like MLP, versus decentralization, market-responsive approaches (Cao et al., 2006). Some research also proposed that increasing government funding, tax incentives with a new strategy for creation and protection of IPR will help to gain incentives for firms to innovate (Fu & Mu, 2014; Hutschenreiter & Zhang, 2007). Therefore we proposed that:

*Proposition 3: Market demand for innovation will have a positive effect on firms' innovation capabilities*

On the other hand, China lacks education and training for entrepreneurship (Gu et al., 2009; Turro et al., 2014; Xu et al., 1998). The government should put more funding towards small firms to encourage managers to look for long-term sustainability. Because of the low market demand for incentives, although company managers in China all know about the importance of innovation, few of them give attention truly to innovation but profit-earning as most firms face the dilemma of low efficiency in translating technology into profit (Gu et al., 2009; Hutschenreiter & Zhang, 2007; Xu et al., 1998). As for firms in China, there still exists a

dominant strategic thinking that views “innovation activities as static, linear, and isolated, thus making technology strategy separate from corporate strategy” (Xu et al., 1998). As mentioned earlier, most firms who succeeded in innovation viewed innovation as part of the organization's culture. Therefore maybe besides the national MLP program, more government funding should be utilized to smaller unsupported enterprises to stimulate innovation. In addition, experts have argued that for China to achieve the desired innovation performance from the vast investment in R&D, improvement in organizational learning, and in interactions between firms and universities and with customers, might be one of the most urgent tasks (Gu et al., 2009; Todtling et al., 2011). There are lack of resources for training in the private sector and serious mismatches between the skills and creativeness that the schools and universities trained students for and the demand in the labour market (Fu & Mu, 2014; Gu et al., 2009). Companies also lack competent managers who have skills to implement strategic management of innovation, by means of planning, incentive setting, evaluation and control (Gu et al., 2009; Hutschenreiter & Zhang, 2007). Therefore there show the importance for regulations on property standard training for workers and managers. Weak dynamic learning is largely the reason for the Chinese often mentioned phenomenon of "import - lag behind - import again" vicious circles or lack of adaptive capacity (Gu et al., 2009). The main reason to be there is a lack of institutions that can design and implement policy and supportive services for capability building and dynamic learning at the firm and industry level in China (Gu et al., 2009). But what is the specific plan to break this cycle and what kind of the government support is needed still remains unknown. However, based on a rational point of view, it is safe to propose that:

*Proposition 4: The policy and government incentives on proper firms training for workers and managers will have a positive effect on dynamic learning and innovation capabilities which then shows a greater improvement in GDP.*

Research has also suggested that innovation is risky and costly and knowledge may generate externalities, which are not easy to appropriate without stringent protection of IPR (Fu & Mu, 2014). This might also suggest that the Chinese culture is risk averse and that might be one of the reasons that firms are not willing to take the risk to invest in R&D (Fan, 2000). Internal brain drain of talent from the innovative sectors to the non-science and technology sectors has become a common problem faced by many countries, including China (Fu & Mu, 2014). It is advisable to use pull policy to attract R&D intensive MNEs and highly-skilled talents to China by improving IPR protection and providing a competitive market environment. However, by simply strengthening the IPR policy might not be the best solution, the loss of high quality personnel might also be the working lifestyle that China has to offer. Work-life balance has been an increasingly important aspect that highly qualified personnel seeks when considering for offers (Fu & Mu, 2014). Perhaps high quality working lifestyle and protection against managers from exploiting labours (over-time workers) is also one of the vital elements that the government should strengthen its regulations on. One of the most successful innovative countries, Japan, uses Theory Z which stresses employee's work-life balance. Therefore we proposed that:

*Proposition 5: There is a positive relationship between work-life balance and innovation capabilities.*

China has been more open ever since the economic reform, but it is mostly limited to economic activities. To attract and retain talented personnel in China, there must be some adjustments made in order to improve its national innovation capabilities. There is no current research on the relationship between political freedom and innovation which is one of the biggest differences between the advanced Western world and China. Therefore we suspect that there might be a casual relationship between them, and it makes sense logically that as political freedom usually offers a greater diversity of thoughts, knowledge sharing, and freedom of speech and communications. These are the factors that can induce innovation as mentioned earlier (Gu et al., 2009; Siguaw et al., 2006; Todtling et al., 2011; Yam et al., 2004) and they might also attract high-quality personnel to China. Therefore we proposed that:

*Proposition 6: There is a positive relationship between the degree of political freedom and innovation capabilities*

## **NATIONAL CULTURE AND INNOVATION**

For the relationship between culture, especially Chinese culture, and innovation, there was not much information found on recent research. One of the reasons might be that it is hard to truly define what represents Chinese culture as a whole; and from the geography point of view, China is a relatively big country with many subcultures and regional cultures. In cities, the modernize cultures which involve the Western culture influence would obviously be much different than the traditional Chinese cultures that exists in the rural areas. Having said that, there were still some factors that were identified that moderate the relationship between culture and

innovation, for example, individualistic cultures, better media portray and higher value of innovation in people's belief seems to increase innovation (Turro et al., 2014).

Little is known about the relationship between these two subjects, innovation and Chinese culture. Culture can be studied at different levels: international, national, regional, industrial, and organizational (Fan, 2000). Most studies on the relationship between innovation and culture focuses on the organizational and the industrial levels as we have mentioned earlier in this paper. Chinese culture is often viewed as value tradition, respect elders and take orders from upper level with no doubt (Fan, 2000; Lockett, 1988). Valuing tradition might be one of the barriers that lead to that China's relatively weak innovation capability. However, because technology advances and fastens the flow of globalization, it might not be the true representation of the new generation of Chinese culture, especially as many articles on Chinese cultures are outdated (Fan, 2000; Lockett, 1988). Because of the rapid globalization, Western culture has a big impact on the modern Chinese culture, especially in the cities. With improved technology and continuous change in society, the attitudes the new generation has towards the traditional Chinese culture and innovation would be much different. One of the informal factors that moderates the effect of cultural values on corporate entrepreneurship is the status and social recognition of corporate entrepreneurs in specific culture group (Turro et al., 2014). In the more traditional culture, it might be seen as disobedience and risky because the costs and probability of failures are relatively high (Fu & Mu, 2014). Research has also identified that one of the Chinese culture values is profit which leads to the findings that we have discussed earlier in this paper that “although company managers in China all know about the importance of innovation, few of the give attention truly to innovation but profit-earning” (Fan, 2000; Gu et al., 2009; Hutschenreiter & Zhang, 2007); therefore the managers’ short-sightedness might be partly due to

the culture effect. However, we argued that short-term orientation is not part of the Chinese culture as identified in these articles. Other research has found that China has been ranked one of the nations with highest scores on long-term orientation (Hofstede, 2001). In the earlier discussion working lifestyle might be one of the reasons for internal brain drain yet lifestyle choices might be embedded underneath the Chinese culture.

One other characteristics of the Chinese culture is that Chinese people tend to be collectivist and highly sensitive to the possibility of losing public social faces which might hinder for innovation (Chen et al., 2005; Fan, 2000; Lockett, 1988; Turro et al., 2014). Current research has shown that individualistic culture fosters entrepreneurship and innovation (Turro et al., 2014); however, we argued that collectivistic cultures do not necessary hinder innovation. From a logical point of view, two heads are always better than one, and as teams brainstorm together, they usually generate more creative results. Even though individualistic culture might help some specially talented people to stand out from the crowd in innovation, a nation's innovation capabilities depend on not just on individual but also on talented personnel to work together to improve the nation's innovation capabilities as a whole. It is now in collectivistic culture's advantage to coordinate between personnel and create a greater benefit to the nation overall. Therefore we proposed that:

*Proposition 7: The Chinese culture has a positive impact on innovation capabilities in China*

## **DISCUSSION**

One of the major contributions of this paper is to give an overview of the current research on the relationships between innovation and organizational cultures, institutional factors and cultures at national level with a specific focus on China. Our paper attempted to extend this stream of research by developing a set of propositions for future research. First, we started by examining the widely accepted notion that flatter organizational structure and decentralization in organizational cultures will help facilitate innovation within firms. Drawing on multiple bodies of related literature, we developed the proposition that there is a positive relationship on innovation and diversity.

Second, we integrate different perspectives often discussed in the relationship between China's innovation capabilities and its unique institutional factors and the recently announced MLP program at national level. Overall we believe that the MLP will bring positive impact on China's innovation capabilities. Thus far little research exists to investigate the effectiveness of the MLP has on China's growth in GDP. We believe this is a critically important yet underexplored issue in China's innovation capabilities. One of the limitations on the MLP is that the program put more focus on the Science and Technology fields whereas other areas of China will need improvement on innovation as well in order to increase a nation's economic sustainability as a whole.

Third, we shift the focus to the relationship between innovation and the Chinese culture at national level as opposed to organizational cultures at firm level. Although other studies have explored the factors that moderate innovation and culture, little research has been done about how Chinese culture impacts the issue of innovation (Todtling et al., 2011; Turro et al., 2014). Some special characteristics of the Chinese culture seem to facilitate innovation logically therefore we propose that there is a positive relationship between Chinese culture and innovation.

Further, although improvement on national innovation capabilities may show propionate growth in China's GDP, research has considered issues of reverse causality. Does the process drive the outcome, or vice versa? Does improvement on overall innovation capabilities leads to China's growth in GDP, or does China's growth in GDP leads to innovation? There is definite conceptual and practical merit in moving toward testing more complex theories involving unanswered questions about causality.

Finally, in future research it might be worthwhile to examine the similarities and differences for the relationships between innovation and other cultures. China is one of the few communist countries in the world with open economy, and therefore, many of the institutional propositions will not be applicable to other countries. However, it is important to compare nations with different cultures and institutional structures to identify a common ground, which will allow a deeper understanding of cross-culture innovation.

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