

# Technical innovation success in China: The use of innovation mechanisms in Chinese SOEs

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**Climate for technical innovation has been improving in the past few years in China. This Paper describes a case research related to technical innovation in three Chinese state-owned enterprises (SOEs) in the manufacturing industry, by applying a Western technical audit tool. The data and findings reveal that the investigated Chinese SOEs have already some mechanisms for innovation in place but there is room for improvement and enhancement with respect to the effect on innovation success. It is also concluded that benchmarking (through the application of the audit tool) may not guarantee improved innovation performance, but it does guide management toward deciding which innovation mechanisms to adopt so as to provide the basics for innovation success. Last but not least we draw the interesting conclusion that in the economy in transition in China, companies with *less* openness to the market (i.e. with high government involvement), there was a *more widespread use of innovation mechanisms*. This finding seems to contradict the positive relationship between market focus and innovativeness as suggested in ‘Western’ innovation management theories, and it enriches to a certain extent the theory of transition.**

## 1. Introduction

The economic environment of China has been changing from the centrally planned economic system to a Western-like open market system. After two decades of gradual, piecemeal reform and opening-up, in particular with China’s entry into the World Trade Organization (WTO), the Chinese state-owned industrial enterprises, which are the main contributors to the government’s revenue and which take 66 percent of the total assets of the industrial sector (Liu and Gao, 1999), are now confronted with fierce challenges from the non-state sectors (such as the private economy, the township and village enterprises (TVEs) and the foreign-funded enterprises).

Management of technology in China has roughly experienced the following phases:

1. Before the reform and opening-up policy in 1978,

China had long been in a self-closed situation except for some technologies introduced from the former Soviet Union and East Europe in the 1950s. The whole country followed the basic tenets of “acting independently and with the initiative in one’s own hands; reconstructing through one’s own efforts”. The government set up technology platforms for industries and let the SOEs design and produce, with no R&D activity involved in an enterprise. A good example of this is like one of our case companies (i.e. LocoCo). It started as a locomotive repairing works. With the Chinese government imported the first locomotive from the former Soviet Union in the 1950s, it began to have its own technology and production in the locomotive industry;

2. From the beginning of 1980s till mid-1980s, the Chinese state-owned manufacturing enterprises

imported a large number of technologies, which saw the focus of technology management in this period as technology selection and project implementation (i.e. technology transformation). Gu (1999) categorized those imported technologies into product designs; manufacturing techniques and equipment; production management techniques (including quality assurance); auxiliary equipment; testing techniques and devices and standards;

3. From the mid-1980s till the late 1990s, the focus was on the localization of imported technology, absorbing and assimilating technology from abroad. Thus the core of technology management in Chinese manufacturing industry was imitation and partly improvement.

The above phases show some similar developments of the Chinese SOEs when compared with Bolwijn and Kumpe's (1990) evolutionary model of Western manufacturing firms. Bolwijn and Kumpe (1990) described the evolvement of large-scale manufacturing firms from the 1960s to the 1990s in terms of market requirement and performance criteria, from "efficient firm" via "quality firm" and "flexible firm" to "innovative firm". This observation leads us to expect that more attention should be paid in gaining knowledge about the effectiveness of management of technical innovation in the changing context of the Chinese SOEs.

Since the late 1990s, the issue of technological innovation has been put on many firms' agenda in China, which drew practitioners' as well as scholars' attention in studying innovation management in the Chinese context (see Gao, 1997; Fu, 1998; Liu, 2001). The above observations brought us the impetus to investigate the possibilities for the application of (Western) good practice in management of technical innovation to the Chinese SOEs. In viewing that the Chinese enterprises are following the similar evolution process of the Western innovative firms, therefore, we set up our objective of this research as, to explore the current innovativeness of three Chinese SOEs in the manufacturing industry, by applying a technical innovation audit tool which is based on Western good practices. Next to the technical innovation audit tool, triangulation methods (Jick, 1979), which are, intensive interviews, in-depth questions and observations are used for validating the findings.

Numerous Western authors have provided an answer to the questions of why to innovate and how to innovate (see for example, Burgelman, Maidique and Wheelwright, 1996; Tushman and Anderson, 1997; Tidd, Bessant and Pavitt, 1997; Radnor and Robinson, 2000; Brockhoff, Pearson, de Weerd-Nederhof and Kerssens-van Drongelen, 2000), but the question is what insights Western theories on good practice in management of technical innovation provide in order to contribute to the knowledge about the effectiveness of management of technical innovation in the changing context of especially the Chinese state-owned enterprises. In a transition economy from a centrally planned system to the market economy, we would argue that the management setting in China is contingent, and we need to use a holistic point of view to study the management of technical innovation in the Chinese context.

This paper firstly describes the theory and method used in this research, mostly on how we used the audit tool developed by Chiesa et al. (1996) for data of the current technical innovation status in the three Chinese SOEs. In the meantime, a triangulation of information (Jick, 1979) was also collected through in-depth questions, intensive interviews and observations in an attempt to examine more deeply the cultural and behavioural activities in influencing the Chinese SOEs' technical innovation capabilities, and to validate some of the empirical results via the technical innovation audit tool. And then this paper illustrates the empirical data in a qualitative way, based on Miles and Huberman (1984). In the concluding section it discusses that Chinese SOEs have some innovation mechanisms in place but more can be done to adapt to the world level. Benchmarking, although it may not guarantee good innovation performance, may guide management in adopting more and other good innovation mechanisms as the basis for successful innovations. We also found that in the economy in transition in China, companies with *less* openness to the market (i.e. with high government involvement), there was a *more widespread use of innovation mechanisms*. This finding seems to contradict the positive relationship between market focus and innovativeness as suggested in 'Western' innovation management theories, and it enriches the theory of transition.

## 2. Method

### 2.1 Case study for this research

Studies on technical innovation in the Chinese SOEs started in the 1990s, but most investigations in this field were based on statistical survey and mathematical modelling (see for example, Gao, 1997; Liu, 2001). However, the explanation of quantitative findings and the construction of theory based on those findings will ultimately have to be based on qualitative understanding (Meredith, 1998), questionnaires and models are constrained by rigid limits, and hard to analyse the software in management of innovation, e.g., human behaviour (Clark and Fujimoto, 1991); whereas case studies lead to new and creative insights, development of new theory, and have high validity with practitioners – the ultimate user of research (Voss et al., 2002). Yin (1994) has described in detail case study design, who argues that the case study is preferred in examining contemporary events, and when a "how" or "why" question is being asked about a contemporary set of events over which the investigator has little or no control. Case research enriches not only theory, but also the researchers themselves. Through conducting research in the field and being exposed to real problems, the creative insights of people at all levels of organizations, and the varied contexts of cases, the individual researcher will personally benefit from the process of conducting the research (Voss et al., 2002). We would believe a case study approach is very important for this research work to examine more deeply

the cultural and behavioural activities in influencing the Chinese SOEs' technical innovation capabilities.

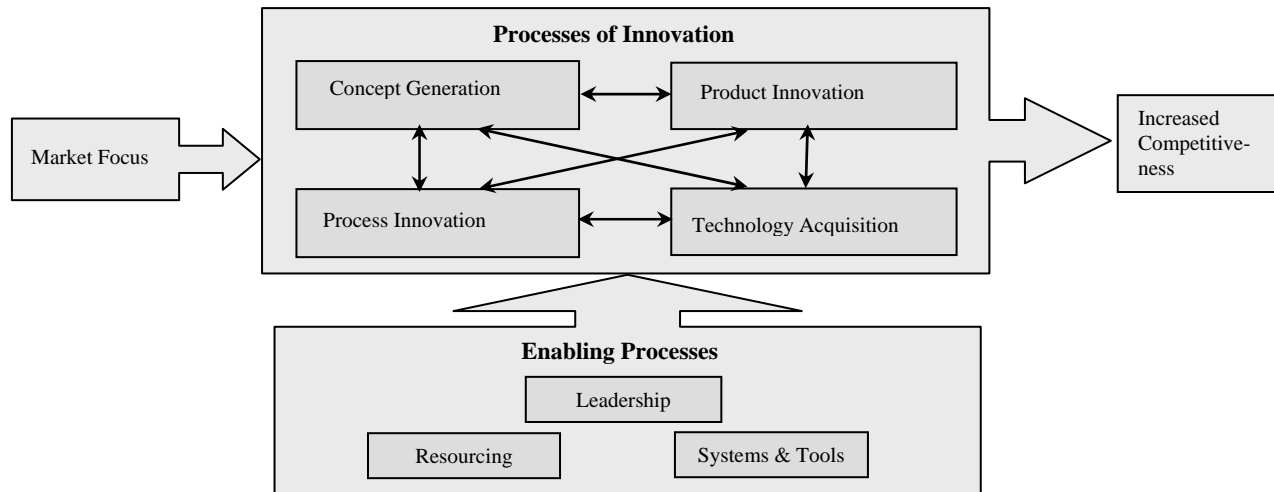
(status quo) of the case companies, namely, LocoCo, BusCo and MotorCo in central China.

## 2.2 A Western technical innovation audit tool

The technical innovation audit developed by Chiesa et al. (1996) is based on a process model (see Fig. 1), which addresses the managerial processes and the organizational mechanisms through which innovation is performed. The model identifies four core processes: concept generation,

## 2.3 Sample selection

In this research, the three SOEs, which are state-owned manufacturing enterprises in the central part of the mainland China, were having different product and production technology, and focusing on different markets and having different size.



Source: Chiesa et al. (1996)

Figure 1. A process-based technical innovation model.

product development, process innovation, and technology acquisition; three enabling processes: the deployment of human and financial resources, the effective use of appropriate systems and tools, and senior management leadership and direction. The outcome from these core and enabling processes is performance in terms of innovation and the resulting competitiveness in the marketplace.

Their technical innovation audit incorporates an extensive Western literature on good practices in management of technical innovation, and, after thorough field testing, it has been widely implemented in numerous UK companies. The use of the tool has helped those companies to identify relevant innovation mechanisms, develop innovation performance measures and audit innovation capability as reported in Chiesa et al. (1996). Chiesa et al. (1996) state that the process of innovation is strongly related to market focus involving the continuous monitoring of customers, competitors and market trends. They believe that the four core processes are inter-related, not isolated, to any innovation, and their process-based technical innovation model indicates that market focus is related to a firm's innovation success. This seems to suggest that their audit tool can be applied to firms which are market-oriented or want to be market-oriented. To facilitate communication during our case study and sharing of Western good practice information with the Chinese managers during the process of our fieldwork, we chose this audit tool after an elaborated review for the assessment of the management of technical innovation

Table 1. Profile of three case companies.

Name in Short	Innovation Features
LocoCo	<ul style="list-style-type: none"> <li>Top management involvement</li> <li>Strong R&amp;D, including a national-level R&amp;D Centre</li> <li>Diverse sources of technology</li> <li>An outward-looking focus for innovation process</li> <li>Enjoy government privilege, no need to worry about orders</li> </ul>
BusCo	<ul style="list-style-type: none"> <li>Breakout profit losing</li> <li>Customer-oriented production and marketing</li> <li>Links with a local university</li> <li>70% are group buyers, innovation is to meet their needs and tastes</li> </ul>
MotorCo	<ul style="list-style-type: none"> <li>Strong imitation strategy for the latest world model(s)</li> <li>Good distribution channels</li> <li>Years of profit losing makes the top management thinking of strategic change in core business due to government limitations in selling its product in cities</li> </ul>

This selection was to avoid the case companies being in the developed east area or in the less developed west region of mainland China. Among the selected samples, one (i.e. LocoCo) ranked the top 500 industrial SOEs in China, another (i.e. BusCo) ranked the top ten of its business scope and the third (i.e. MotorCo) the top five producer of its kind product. The first sample company employed around 10,000 people, and the second and the third employed over 2,400 and 6000 people respectively. All three shared the same historical background and similar stakeholder compositions as traditional state-owned manufacturing companies.

## 2.4 Process of data gathering

To ensure that comparable data to be collected from each SOE, the same assessment tool was delivered to the key informants, who were the three functional managers (i.e. the Production Manager, the R&D/Product Development Manager and the Sales and Marketing Manager) and one (vice) General Manager or vice President in Technology. In order to get informed responses from the three companies, intensive interviews with open-ended, in-depth questions were carried out to the key people who were knowledgeable about their firms' strategic orientations and who took direct control of technological

innovation activities of their enterprises.

Detailed explanation to the scorecard was given to the (vice) General Manager or vice President in Technology and the functional managers on how to fill it out. For example, each item has four scales ranking from one to four, and scale four is considered to be the 'world class' innovation performance (see Chiesa, 1996). The use of the four-scale ranking presented us with bias because companies came to fill in a high score to make their company look not too bad, which has to do with the Chinese traditional behaviour of "preserving of face". Therefore we stressed consistently the needs for the use of innovation mechanisms instead of the individual performance of their company, and we kept on refreshing the scales with semi-structured, in-depth questions. Their answers were compared with their scoring of the innovation scorecard. From LocoCo to MotorCo, and then BusCo, to keep the case research consistent, we delivered the same innovation assessment tool, asked the same questions to different informants, and kept the same percentage of people in answering our in-depth questions for reliability. In combination with data by using triangulation methods, we tried to keep all information from diverse research methods to be in line with each other, and the current technical innovation situation of the three SOEs is depicted in Fig. 2.

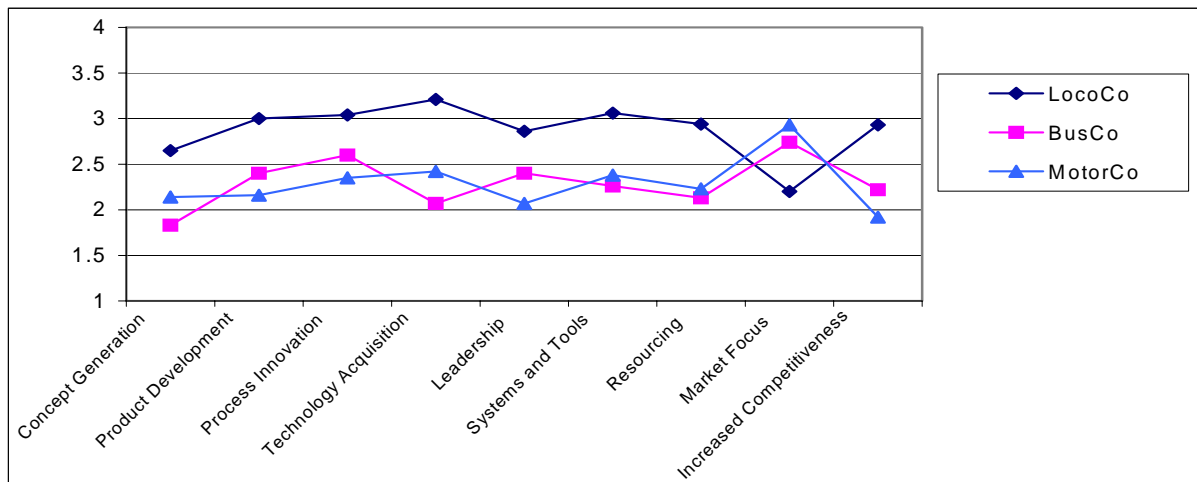


Figure 2. A linear description of the current innovation situation in the three SOEs.

## 2.5 Results to date

After reviewing the within-case studies of the three case companies, the key information which is considered to be the results of the triangulation of methods (Jick, 1979) was collected. Miles and Huberman (1984) have written a guide for the analysis of and display of qualitative data. In brief, they encourage the use of tables to display key

information, which more specifically for innovation research is also recommended by Radnor and Robinson (2000). So the key technical innovation practices within the three case companies are displayed in the tables below, including the core processes of the innovation process (Table 2) and the enabling processes of the innovation process (Table 3).

Table 2. The core processes of the innovation process

	LocoCo	BusCo	MotorCo
Product innovation planning	Yes	No	N/A
Innovation rewards	Yes	Yes	No
Innovation risk-taking	(no risk)	No	No
Use of multi-discipline teams with early involvement	No	No	No
Cross functional teamwork	Some	No	No
Employees involved in continuous improvement	Yes	Some	No
Industrial design	No	Some	Some
Diversified technology sources	Yes	No	No
Technology strategy identified	Outward-looking	Inward-looking	Inward-looking
New ideas from:	R&D	Customer demands	Competitors
	Global competitors	Suppliers	Marketing
	Local customer needs	Competitors	Special magazines

Note: According to Chiesa et al. (1996) the core processes of the innovation process consist of concept generation, product innovation, process innovation and technology acquirement.

Table 3. The enabling processes of the innovation process

	LocoCo	BusCo	MotorCo
Top management involvement	Yes	Yes	No
Clear innovation goals	Yes	(short-term)	(short-term)
Management attention to encourage innovation	Yes	No	No
Training program for staff	Yes	No	No
Innovation process properly funded	Yes	No	No
Intranet and internet used to facilitate information and design	Yes	Some	Some

Note: According to Chiesa et al. (1996) the enabling processes of the innovation process consist of leadership, resourcing and systems and tools.

A distinctive phenomenon in Fig. 2 is LocoCo has a better use of innovation mechanisms and a low score in market focus. Whereas BusCo and MotorCo are more market oriented with less innovation mechanisms and their competitiveness in the market is rather low.

Table 2 and Table 3 summarize the use of innovation mechanisms in the three Chinese SOEs. These are the results from our fieldwork with a triangulation of research methods. LocoCo shows that it has already most innovation mechanisms in place; BusCo shows that it has only some mechanisms in place; and MotorCo has even fewer in place.

According to Chiesa et al. (1996), management of technical innovation is a process which consists of all four core processes and three enabling processes. LocoCo's has enabling processes and mechanisms in place and has more use of innovation mechanisms in their core processes, but still, there are no multi-disciplinary teams with early involvement in a new project or new product development; cross-functional teamwork is weak; and there is almost no industrial design for market demand. BusCo and especially MotorCo still lack most technical innovation mechanisms in both core processes and enabling processes. These two

companies do not want to take innovation risks because they think they cannot afford to fail; there is no product planning but they follow the popular models in the world with an inward-looking technology strategy. Also they miss most enabling processes such as innovation funds and human resources (we were told, for instance, that MotorCo's R&D staff in 2000 even dropped from 60 to 40, and in the company newspaper we read that MotorCo's employees were complaining about the leadership of the top management).

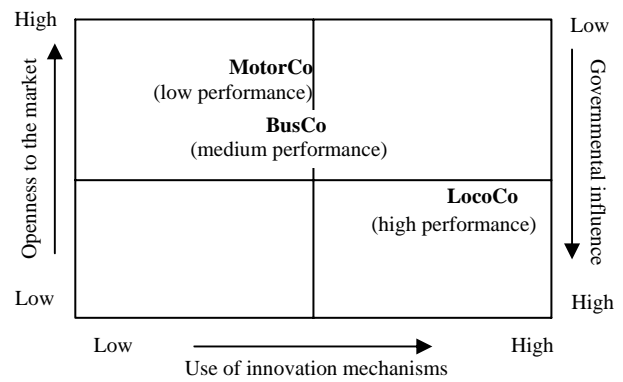
### 3. Discussion

Our fieldwork with a triangulation of research methods (i.e. the audit tool in combination with observations, open-ended questions and intensive interviews to relevant functional managers) shows that the use of innovation mechanisms in the three Chinese SOEs varies. Table 2 and Table 3 show that LocoCo has considerably more use of innovation mechanisms than that of BusCo and MotorCo, partly due to the role of its important stakeholder, i.e. government (see Ren, 2004).

The dynamics of stakeholder composition is considered influential to three case companies' effectiveness of technical innovation management. The stakeholder compositions of the three companies were similar, but stakeholders own different attributes of power, legitimacy and urgency (Mitchell et al., 1997), especially the influence of two main stakeholders' roles, namely, government and customer/market. The government/end user or customer influence on the different cases showed a high/low influence on LocoCo, and a low/high influence on BusCo and MotorCo. This seems to oppose to that in the Western world. Although the stakeholder situation of MotorCo and BusCo is in line with the Western world, it does not lead to an increased use of innovation mechanisms, whereas in the case of LocoCo, where the government still plays an important role, we found more use of technical innovation mechanisms. This was indicating that in the Chinese traditionally planned economy, social, political and institutional effects still have dominant impact on SOEs' innovation competitiveness. Stakeholders' influence on technical innovation is prominent, and this is especially true for the transitional economic situation of China. The stakeholders are important for the management of technical innovation of the Chinese SOEs because they provide the SOEs with scarce resources, which determine the smooth implementation of technical innovation.

Based on our studies on innovation mechanisms used in the case companies and the stakeholder influence discussed above, we realize that there are essentially three dimensions that indicate the current innovation situation of the three SOEs, illustrating the relationships between the change in stakeholder situation and the use of innovation mechanisms: Use of innovation mechanisms, Openness to the market and Governmental influence. On the one hand, LocoCo has the highest use of innovation mechanisms and a low position in market focus. On the other hand, BusCo and MotorCo are more market oriented with less innovation mechanisms and their competitiveness in the market is rather low. In our research, the intriguing finding was that in the transition economy of China, the higher the openness to the market and lower protection of the government, the less innovative and competitive the company. To put it in other words, BusCo and MotorCo seem to have to "defend" their own "turfs". More precisely, LocoCo is in a (semi-) monopoly sector with a lower openness to the market and higher protection of the government in various aspects, but its innovation performance is high. For MotorCo, it is the other way around. The interface of the openness to the market and government interference, and the innovation performance of BusCo are in between of LocoCo and MotorCo.

Based on our research we can roughly draw the conclusion that the prominent influence by the Chinese government's control on SOEs', such as personnel appointment and interference on managerial issues have been found to negatively influence the vitality of the



SOEs, especially in the aspects of technological innovation capability and creativity. Surprisingly however, large-scaled Chinese SOEs like LocoCo, which in the past decades have saved cumulative technology and equipment and still enjoy the government's privileges in financial appraisal and industrial policies, will take the lead among the Chinese SOEs to be innovative in the short run; other large and medium SOEs with market-orientedness will be staying in the dilemma situation whether to take the risk of innovation or to "wait for death" without innovation.

What we could find was the shift of stakeholder composition of the SOEs, but we found no evidence that SOEs that became more market-oriented became more innovative in product and process than those who are still in the semi-closed market despite of industry maturity. In our research, for example, MotorCo and BusCo are more open but much less innovative. The research also substantiates that incurring debt motivates managers to sacrifice long-term investment in favour of short-term cash flow. This seems to oppose the Western literature and theory in which market-orientedness is supposed to lead to increased use of innovation mechanisms. In the innovation process model of Chiesa et al. (1996), for example, the market trend is also seen as the main driving force for the carry out of technical innovation, indicating that Western firms in competitive situation take innovation as a means to increase competitiveness in the marketplace. One would expect that the changing stakeholder situation of the Chinese SOEs, when confronted with the market situation, should generate industrial innovation within the firms and bring more orders from the market automatically. But this did not happen in our three cases, and it even seems to go the other way around. Looking for explanations for all these facts, we look at Miles et al.'s (1978) theoretical framework for the analysis of organizations in their adaptive processes.

According to the characteristics of the four strategic types of organizations identified by Miles et al. (1978), the three case companies in this research could be firstly mapped into the category of Defenders, whose success comes primarily from efficiently serving a stable domain and whose primary risk is that of ineffectiveness. But with China's reform and opening-up policy, the three SOEs have had to adapt themselves to the changing economic environment. Started as a Defender, BusCo and MotorCo held the *administrative problem* of how to maintain strict control of the organization in order to ensure efficiency. As a result, their administrative system as well as technology are ideally suited to maintain stability and efficiency but are not well suited to locating and responding to new product or market opportunities.

Figure 2. The relationship between the openness to the market and the government influence and use of innovation mechanisms in the three Chinese SOEs.

In the process of adaptation, these two SOEs were confronted with the open market situation, and they managed to adjust their *entrepreneurial problem* and *engineering problem* from a Defender to an Analyser, with the characteristic of attempting to minimize risk while maximizing the opportunity for profit. On the one hand, especially in the design of their administrative system and organization, they still have the characteristic of a Defender, trying to keep the current fairly stable set of products and customer or client group; on the other hand, they wish to expand new products or new markets. That can be the reason why imitation for them is accomplished only when the most successful product or market innovations developed by prominent Prospectors are adopted.

Miles et al. (1978) state, "*The successful Analyser must be able to respond quickly when following the lead of key Prospectors while at the same time maintaining operating efficiency in its stable product and market areas*". However, BusCo and MotorCo's use of innovation mechanisms and their competitiveness in the market, and MotorCo's in particular, were showing the adaptive cycle of a Reactor – responding inappropriately to environmental change and uncertainty, performing poorly as a result, and then being reluctant to act proactively in the future. Based on Miles et al. (1978), this was because of the "lagging" aspect of the administrative system in the adaptation process. In other words, in the process of adaptation, BusCo and MotorCo's *entrepreneurial problem* and *engineering problem* were moving towards the characteristics of an Analyser, but their *administrative problem* made their performance lagging behind.

However, Miles et al.'s (1978) theory does not seem to be workable to LocoCo. Also started as a Defender, in its adaptive process during the economic environment in transition in China, LocoCo's privileged position, i.e. being in a (half) monopoly industry with the protection of the government, provided it with advantages to have the tendency to become a Prospector. For LocoCo, since there is no risk for new project and new product development, maintaining the reputation as an innovator in product and market development is as important as, perhaps even more important, than high profitability, whose prime capability is that of finding and exploiting new product and market opportunities. This finding is opposite to Miles et al. (1978), who propose, "*Unless an organization exists in a "Protected" environment such as monopolistic or highly-regulated industry, it cannot continue to behave as a Reactor indefinitely*". We are not sure whether the case of LocoCo, which is under the government's protection and in a monopolistic industry but with innovative vitality, happens only in China. BusCo and MotorCo are defending their domestic market, while LocoCo is trying to expand for international market share, which fits for the characteristics of an Analyser. Looking back to Bolwijn and Kumpe's (1990) evolution model of firms in different business environment, we could see that it took Western firms over 30 years developing from efficient firms till today's innovative firms, Chinese firms cannot do it by just a quantum leap, with the Chinese

government artificially opens the market.

In their technical innovation process model, Chiesa et al. (1996) indicate that firms which are market-oriented would be more innovative. "Market-oriented" firms to a certain extent refer to those that are proactive to adapt to the environment change. China is now a rather open market, but this openness is a governmental activity, which means the government artificially created the open market for the Chinese SOEs by introducing competitions and regulations by leaving the SOEs structure and managerial process with little change, which will not automatically result in more innovation initiatives of the SOEs.

Through our investigation, the findings of the study and Chiesa et al.'s (1996) good practice benchmarking idea also provided the SOEs' managers with fresh insight into their ongoing innovation activities. All the three companies assured that factors external to the company influence the organization's innovation, and the government's role in operation and management is gradually declining, but the consistent administrative control (i.e., personnel appointment) of the government to the SOEs constrains the SOE managers' innovation initiatives. Managers believe that basically they control the innovation activities within their firms and think that external factors have influence on the innovativeness of their firms. They also agreed that with effective management and incentive mechanism, good innovation outcomes can be realized, and company indigenous technology development ability will accelerate as it develops its own technology generating capability.

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