9. The effect of organizational reward and control on firm innovation and financial performance in Chinese technology firms

Yuan Li, Dan Li, Haiyang Li and Yongbin Zhao

INTRODUCTION

Recent literature has witnessed increasing attention to the growth of high technology firms in emerging markets such as China, India and Russia (Bruton & Rubanik, 2002; Li & Atuahene-Gima, 2001; *The Economist*, 2004). The development of technology firms represents a driving force for economic transformation in these emerging markets. Technology firms not only help develop new wealth, but also create new employment opportunities. For example, in Zhongguancun Science Park in Beijing, China, there were more than 9500 firms with 400 000 employees and industrial outputs of US$22.8 billion up to 2002. This output contributed two-thirds of the industrial growth of Beijing (Beijing Bureau of Statistics, 2002).

The importance of technology firms for wealth and job creation has led researchers to search for factors that predict these firms' survival and success. Several scholars have demonstrated that firm innovation in the form of new products and processes has become increasingly important as a way for technology firms to achieve competitive advantages (Eisenhardt & Schoonhoven, 1990; Li & Atuahene-Gima, 2001). However, firm innovation does not occur in a vacuum. To ensure success in the development of new products or new processes, it is important for technology firms to manage effectively (for example, with reward, and control) their innovating employees to improve firm performance.

Previous studies on the organizational reward–innovation relationship have reported mixed results. Some researchers have shown that material rewards (such as bonuses and pay increases) can encourage innovation (for example, Baer, 1997, Eisenberger & Cameron, 1996) while others have disclosed evidence to the contrary; for example, Amabile and colleagues (for example, Amabile, 1983; Amabile, Hennessey & Grossman, 1986;

Hennessey & Amabile, 1998) found that material rewards are detrimental to innovation. The mixed findings may stem from the fact that prior research has defined innovation very broadly and failed to distinguish between different types of innovations (that is, incremental innovations versus radical innovations). Thus, without specifying the nature of innovation type, the linkage between reward mechanisms and innovation cannot be theoretically developed.

Organizational control literature describes control as a process of monitoring and evaluating behaviours and outcomes (Jaworski, 1988; Ouchi, 1980). Drawing upon Jensen's (1993) argument that the major source of failure of the market for corporate control regarding innovation is internal control systems, Hitt, Hoskisson, Johnson and Moesel (1996) examined the effect of internal managerial control systems (that is, strategic controls and financial controls) on firm innovation. While insightful, their study is limited to the context of merger and acquisition and they focused on control systems for business-level or divisional managers. So far, no study has examined organizational controls of innovating employees and how these controls may affect the development of different types of innovation (for example, incremental and radical innovations), particularly in an emerging market context.

In this study, we attempt to advance the literature in several ways. First, we draw upon the innovation literature by making a distinction between two types of firm innovations: incremental innovation and radical innovation (Dewar & Dutton, 1986; Hill & Rothaermel, 2003). We add to the literature by simultaneously examining the effects of both organizational rewards and controls on these two types of firm innovations. Second, the literature has suggested that innovation can help firms catch up with the opportunities in uncertain environments to build/maintain their competitive advantage, and sequentially benefit their long-term performance. Although some scholars (for example, Foster, 1986; Hill & Rothaermel, 2003; Tripsas & Gavetti, 2000) have studied the relationships between innovation and firm performance, it is still unclear whether radical innovation and incremental innovation have the same effects on firm performance.

Third, our focus on technology firms in China's emerging market also represents a contribution. Previous studies on the relationship between organizational reward, control and innovation have mainly been done in the developed markets which are characterized by individualism (that is, people look after their own interests rather than the interest of in-groups) and low uncertainty avoidance (that is, people tolerate ambiguity and uncertainty). Different from the Western developed countries, China is a collectivist and high uncertainty avoidance society (Hofstede, 1997). In the West, managers have the power to control some behaviours but employees

retain control over others. However, the Chinese managers may control every sphere of life of their employees (Atuahene-Gima & Li, 2002). Thus how firms reward and control employees has more far-reaching implications for innovation in the Chinese context than in the Western countries. Therefore our focus on Chinese technology firms can enrich our understanding of how the effects of organizational reward and control mechanisms on innovation and further firm performance can be different in a different national culture context.

The rest of the chapter is organized as follows. We first review the relevant literature on organizational reward, organizational control, innovation and firm performance. We then develop our research hypotheses. Figure 9.1 illustrates the theoretical model proposed in this chapter. In the empirical sections, hypotheses are tested using a sample of 194 technology firms in China. The chapter ends with a discussion of the results and implications for both researchers and practitioners.

THEORY AND HYPOTHESES

Theoretical Background

Firm innovations have been generally classified into two types: *radical* and *incremental innovations* (Dewar & Dutton, 1986; Hill & Rothaermel, 2003; Sheremata, 2004). Radical innovations are based on new design concepts that break paradigms, whereas incremental innovations are based on minor improvements or adjustments in the current product or technology. Radical innovations are based on the knowledge that is largely different from current knowledge, or comes from a mix of current knowledge and entirely new knowledge. In other words, radical innovations involve fundamental changes or development in current product or process. In contrast, incremental innovations are sustaining of the existing status quo (Hart & Christensen, 2002; Tushman & Rosenkopf, 1996). They are a development of current product and process based on current knowledge and they involve minor improvements or simple adjustments in existing product technology (Hill & Rothaermel, 2003). The major difference between radical and incremental innovations is the degree of novel technological process content embodied in the innovations. A radical innovation represents a clear departure from existing products or process. It incorporates a large degree of new knowledge and involves a high level of risk and resource consumption (Dewar & Dutton, 1986).

Designed to promote employees' efforts in innovation, organizational rewards can vitalize the latent ability of employees by arousing their passion

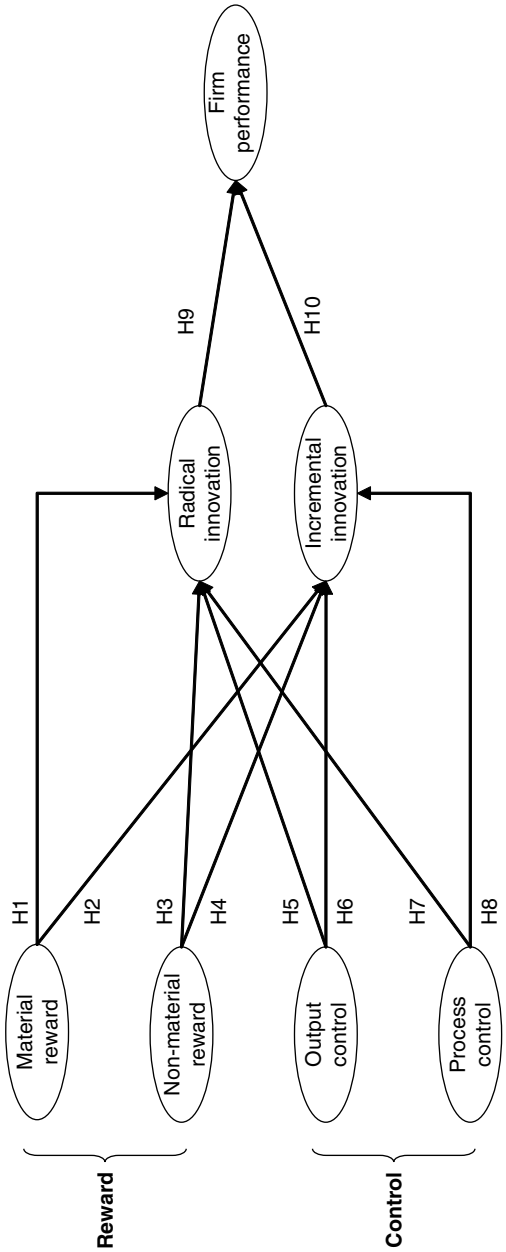

Figure 9.1 Theoretical framework

for work and inspiring their enthusiasm and spontaneity. Organizational rewards can compensate the potential risks faced by employees in developing innovations. Generally, organizational rewards can be divided into *material* and *non-material* rewards (Henderson, 1989). Examples of material rewards include basic wages, bonuses, allowances, and so on. Because the capital market is still underdeveloped in China, most technology firms can not use stocks and/or stock options to motivate their employees. Therefore, the reward mechanisms are relatively simple; the commonly used organizational rewards are to increase salary and provide bonus. Examples of non-material rewards include honor, recognition, and public praise, and so on. Non-material rewards play an essential role in China where the national culture places more emphasis on face/reputation rather than financial possession (Chow, 1992).

In addition to organizational rewards, organizational controls are necessary to enhance efficiency in innovation processes. Researchers have argued that organizational controls can ensure the accomplishment of firms' innovative goals as planned beforehand (Robbins, 2001). In this study, we focus on two formal control mechanisms: *process control* and *output control* (Ouchi, 1980; Eisenhardt, 1985). Process control refers to the extent to which managers emphasize procedures and behavioural activities in monitoring and evaluating their employees. In contrast, output control refers to the extent to which managers place emphasis on outcomes when monitoring and evaluating their employees (Atuahene-Gima & Li, 2002). Our focus on formal controls is not to deny the importance of social controls such as self-control and cultural controls which are unwritten and typically represent a worker-initiated system that influences workers' behaviour (Jaworski, 1988:26). Our interest is in formal controls because they are written, management-initiated mechanisms that influence the probability of employees behaving in ways that support the stated managerial objectives such as innovation outcomes.

EFFECTS OF ORGANIZATIONAL REWARDS ON FIRM INNOVATION

Individuals' behaviour can largely be explained in terms of two dominant interests: economic gain and social acceptance (Blau, 1964; Henderson, 1989). The rationale behind material rewards is to satisfy individuals' needs for economic gain, while the rationale behind non-material rewards is to meet their needs for social acceptance. Thus material and non-material rewards can satisfy employees' different needs in developing innovations.

We argue that material reward is negatively related to radical innovations, but positively related to incremental innovations. Radical innovations involve a high level of risks and uncertainties. It usually takes more time and more resources to develop radical innovations but the outcomes are uncertain. Amabile (1983) suggests that, in situations involving a large amount of uncertainties, the overemphasis on external and objective performance reduces the intrinsic incentive and curiosity needed for innovation work. A series of studies by Amabile and her colleagues (Amabile, 1983; Amabile *et al*., 1986; Hennessey & Amabile, 1998) indicate that extrinsic rewards – concrete tangible rewards such as bonuses, pay increases and awards – are detrimental to innovation. This is particularly true in China where employees in technology firms typically receive a higher salary than employees in other industries. Therefore, for employees who have already enjoyed high salaries, material rewards may be less effective in motivating them to engage in radical innovations involving high risks. Further, in a country emphasizing honour and reputation, employees' confidence and feeling of achievement may be harmed by organizations which only provide material rewards. In such situations, employees may try to avoid radical innovation to reduce their responsibilities in case the radical innovation fails.

In contrast, incremental innovations involve minor adjustment and development of current products and processes, which have a low degree of risk and high likelihood of success. Thus it is relatively fast and easy to observe and evaluate the outcomes of incremental innovations. When material reward is utilized and objective goals are set, employees consider not only the possible economic gain from developing innovation but also the potential loss if their innovations fail. Therefore the employment of material rewards can prompt employees to focus on developing innovations that are easy to accomplish, most of the time, incremental innovations.

H1: In Chinese technology firms, material reward is negatively associated with radical innovation.

H2: In Chinese technology firms, material reward is positively associated with incremental innovation.

Organizational rewards, to be effective, must be consistent with commonly held cultural values about work (Chow, 1992). Non-material reward plays an essential role in China where employees consider face/reputation more important than financial possession. When employees receive non-material rewards such as public praise, they feel that they are acknowledged by their organizations and their face/reputation is upheld. As a consequence, employees are more willing to conduct innovations including both

radical and incremental innovations Non-material reward is particularly important for radical innovations, which are more venturesome. The development of radical innovations usually takes longer than that of incremental innovations. Also the outcome of employees' innovation efforts is less predictable for radical innovations than for incremental innovations. Innovating employees need time to appraise and select multiple goals, requiring firms to provide flexibility to develop their work activity (Mumford, 2000). Additionally, for employees developing radical innovations, personal growth and self-realization are more valuable than receiving material reward. Non-material rewards can work better than material rewards in motivating employees to develop radical innovations.

H3: In Chinese technology firms, non-material reward is positively associated with radical innovation.

H4: In Chinese technology firms, non-material reward is positively associated with incremental innovation.

ORGANIZATIONAL CONTROLS AND FIRM INNOVATIONS

Technology firms use different organizational controls to ensure that innovations will be effectively developed and commercialized. Here we use agency theory to explain the relationships between organizational controls and firm innovations. Agency theory assumes that both the agent (for example, innovating employee) and the principal (for example, technology firm) are rational and self-interested and the agent is both effort- and risk-averse (Bloom & Milkovitch, 1998; Eisenhardt, 1989). This creates a moral hazard, in which the agent tends to maximize compensation without exerting the effort required to maximize the principal's goals.

Output control represents a 'hands-off' approach to managing innovating employees, in that they are given a great deal of autonomy and independence to perform their duties and are compensated for the output they achieve (Atuahene-Gima & Li, 2002: 65). Thus output control shifts substantial innovation risks to the innovating employees because their outputs may be affected by environmental and company factors beyond their control. As Whitener *et al*. (1998: 515) argue, to the extent that the employee is compensated on the basis of outcomes beyond his or her control, the performance risk to him or her is higher. When developing radical innovations, employees face considerable uncertainties about future outcomes. Under this condition, both the firm and the employees tend to minimize their own

risks. Thus a purely output-based reward structure is likely to be counterproductive for employees developing radical innovations because it places an excessive amount of risk on the employees. Further, when an organization emphasizes output control, the appraising standards are usually short-term oriented (Hayes & Abernathy, 1980). Previous studies have shown that the organization whose incentive is based on short-term financial outcomes always has comparatively little investment in R&D (Hoskisson, Hitt & Hill, 1991; Hoskisson, Hitt, Johnson & Moesel, 1993). These results suggest that output control can be detrimental to radical innovations.

In contrast, employees are more likely to conduct incremental innovation when the output control is utilized. Incremental innovation involves less risk and takes less time and thus employees face less uncertainty about future outcomes in developing this type of innovation. In this situation, employees can take advantage of the autonomy and independence given by the firm to perform their innovation activities without worrying about the potential risks.

H5: In Chinese technology firms, output control is negatively associated with radical innovation.

H6: In Chinese technology firms, output control is positively associated with incremental innovation.

Process control reflects the extent to which a firm emphasizes procedures and behavioural activities in monitoring, evaluating and rewarding employees. Process control ensures that employees receive rewards as long as process requirements are met, irrespective of the output achieved (Atuahene-Gima & Li, 2002). It therefore reduces the pressure and risks in developing radical innovations because it is the firm, rather the innovating employee, who assumes much of the performance risks. Consequently, although process control may limit autonomy and independence of the employees, it sends a positive signal of the firm's concern, care and support to the employees who are developing radical innovations.

By using process control, employees at different organizational hierarchical levels can exchange information more efficiently (Hoskisson, Hitt & Ireland, 1994; Hitt *et al*., 1996). Top managers who stress process control always take part in and direct subordinates' activities, which is helpful to constructing a system to share responsibility for innovations between managers and employees. Because employees can feel the support from the managers, and believe their performance will be appraised according to the efforts devoted rather than short-term outcomes, they will be more willing to take risks and responsibilities involved in radical innovations

(Hitt *et al*., 1996). Similarly, Scott (1995) argues that directing process and approach, rather than specifying a single desired outcome, better manages radical innovations.

However, introducing process control into an incremental innovation process may increase unnecessary costs and discourage the development of innovations. As we argued previously, a potential disadvantage of process control is that it could be perceived by employees as limiting their self-control and autonomy. Particularly in developing incremental innovations which has characteristic of low risk and small steps on adjustment of existing technologies or products, too much monitoring from the managers can make the employees feel that their managers do not trust their capabilities of innovation and that they have limited autonomy. Under this condition, process control can be negatively related to incremental innovation.

H7: In Chinese technology firms, process control is positively associated with the radical innovation.

H8: In Chinese technology firms, process control is negatively associated with the incremental innovation.

INNOVATION AND FIRM FINANCIAL PERFORMANCE

Innovation is important to value creation. Prior studies have shown that firm innovation has enormous effects on firms' survival and success (Damonpour, 1991; Dougherty & Hardy, 1996; Nohria & Gulati, 1996). In technology-intensive industries, firms face quickly changing market and technology environments where new products are developed at any moment. Technology firms have to innovate constantly to maintain long-term competitive advantages. Any firm which cannot innovate or whose innovations are not successful in time would be eliminated from the market. However, not all kinds of innovations are helpful for firm performance, particularly for long-term financial performance.

In general, radical innovations are critical for firm performance because, once a radical innovation succeeds, it will represent a high obstacle for rivals. Thus radical innovations can help firms achieve long-term competitive advantage. However, radical innovations are expensive. They are characterized by tremendous resource requirements and a high level of risks. Investing a tremendous amount of financial and human resources in radical innovations may drag down a firm's performance in the short run,

yet radical innovation can bring firms long-term competitive advantage and continually increase firm performance in the long run. In contrast, incremental innovation can bring firm performance advantage in the short run, but cannot produce sustained competitive advantage for the firm in the long run. As a matter of fact, the emphasis on incremental innovations can be harmful to a firm's financial performance if the firm cannot catch up with its competitors by adopting radical innovations.

The above argument is particularly valid in the Chinese context. In a recent study, Hitt, Li and Worthington (2005) argued that, because of the potential of the Chinese market, both local firms and foreign entrants are experiencing significant competition in this market. Thus both local firms and foreign entrants must acquire the necessary knowledge as rapidly as possible to remain competitive. This requires an exploratory learning process which involves experimentation with new alternatives and developing radical innovations. Thus, we propose the following:

H9: In Chinese technology firms, radical innovations are positively associated with firm financial performance in the long run.

H10: In Chinese technology firms, incremental innovations are negatively associated with firm financial performance in the long run.

Methodology

Data collection and sample

We randomly selected 300 firms from the list of technology firms provided by the Committee of Economy and Commerce from eight provinces – Shaanxi, Henan, Shanghai, Guangdong, Liaoning, Sichuan, Shandong and Shanxi. We contacted chief executive officers of these firms to introduce the study and encourage their participation. A total of 280 firms agreed to participate in this project. We collected data through on-site interviews with a questionnaire. We assured all respondents of confidentiality to encourage their candid responses. Each interview took about 60 to 90 minutes. Our data collection efforts yielded 194 completed questionnaires for a participation rate of 64.7 per cent (=194/300). A brief description of sample characteristics is summarized in Table 9.1.

Measures

Material reward

We used three items to measure material reward. The respondents were asked to indicate the extent to which they agree that the following reward

Table 9.1 Sample characteristics (N = 194)

Sample characteristics	Percentage
Industries	
Material industry	5.2
Chemical industry	9.3
Electronic industry	40.2
Engineering industry	25.2
Medicine	12.9
Other industry	7.2
Employee numbers	
50 or less	18.5
51–200	37.1
201–500	19.1
501–1000	9.3
1000 or more	16.0

approaches work for them in conducting innovation activities: (1) increasing individual material fortune, (2) increasing opportunity to gain economic interest, and (3) guaranteeing the future living of home members. Responses were based on a scale ranging from 1 (strongly disagree) to 7 (strongly agree). The Cronbach alpha for this measure was 0.85.

Non-material reward

Non-material reward was also measured by using three items. The respondents were asked to indicate the extent to which the following reward approaches work for them in conducting innovation activities: (1) acquiring social acceptance, praise and honour; (2) obtaining individual opportunity by accepting the challenge of the innovation; and (3) obtaining individual self-development. Responses were based on a scale ranging from 1 (strongly disagree) to 7 (strongly agree). The Cronbach alpha for this measure was 0.78.

Process control

We developed the measures of process control by modifying the items from Xu and Wang (1997). We asked the respondents to indicate the extent to which they agree that top managers in their organization control firm innovation activities by: (1) permitting the employees' mistake taking place in the innovation process, (2) developing highly trusting relationship between managers and employees, and (3) monitoring the extent to which employees follow established procedures for innovations. Responses were

based on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The Cronbach alpha for this measurement was 0.88.

Output control

The measures of output control are mainly taken from the research of Hitt et al. (1996). We asked the respondents to indicate the extent to which they agree that top managers in their organization control innovation activities by: (1) exerting high requirement on ROI (return on investment) of the innovation, (2) ensuring cash currency being abundant through the innovation, and (3) requiring the increase of the net assets in the innovation process. Responses were made on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The Cronbach alpha was 0.74.

Radical innovation

We measured radical innovation by using four items that were modified from Ettlie *et al*. (1984) and Dewar & Dutton (1986). The questions are, to what extent do you agree with the following statements: (1) your firm develops new products which have completely new functions in the market, (2) your firm conducts product innovation by frequently introducing new technologies, (3) your firm conducts process innovations by introducing completely new technologies in the industry, and (4) your firm conducts process innovations based on breakthrough concepts. Responses were based on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The Cronbach alpha was 0.77.

Incremental innovation

We measured incremental innovation by using three items modified from Ettlie *et al*. (1984) and Dewar & Dutton (1986). The questions are, to what extent do you agree with the following statements: (1) your firm develops new products which some new style and services in the market, (2) your firm conducts process innovation by frequently modifying and improving the firm's existing technologies, and (3) your firm conducts innovations by improving current products and processes based on current knowledge. Responses were based on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The Cronbach alpha was 0.66.

Firm performance

We measured firm's financial performance by using multiple items. Reliance upon multiple performance measures is important, as no one indicator reasonably captures firm financial performance (Bourgeois, 1980; Chakravarthy, 1986; Weiner & Mahoney, 1981). We asked the respondents to indicate the extent to which they agree that their firms have achieved

the following outputs in the past five years (1997–2001): (1) increasing rate of sale revenue; (2) increasing rate of profit; (3) increasing rate of ROI (return on investment); and (4) increasing rate of market share. Responses were based on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The Cronbach alpha was 0.85.

Results

We tested the hypotheses using structural equation modelling (SEM) techniques as implemented in AMOS 4.0. Our analysis follows the two-stage procedure recommended by Anderson and Gerbing (1988): (1) estimating the model's reliability and validity, which can ensure that the variables in the following analysis are reliable and valid and (2) testing the theoretical model.

Table 9.2 reports the reliability of all items for our measurements.

Table 9.2 Results of confirmatory factor analysis

Factors	Items	Loading	alpha
Material reward	1. increasing individual material fortune	0.796	0.85
	2. increasing opportunity to gain economic interest	0.862	
	3. guaranteeing future living of home members	0.866	
Non-material reward	4. acquiring social acceptance, praise and honour	0.796	0.78
	5. obtaining individual opportunity by accepting the challenge of the innovation	0.830	
	6. obtaining individual self-development	0.871	
Process control	7. permitting the employees' mistake taking place in the innovation process	0.933	0.88
	8. developing highly trusting relationship between managers and employees	0.935	
	9. monitoring the extent to which employees follow established procedures for innovations	0.840	
Output control	10. exerting high requirement on ROI of the innovation	0.590	0.74
	11. ensuring cash currency being abundant through the innovation	0.928	
	12. requiring the increase of the net assets in the innovation process	0.912	

Table 9.2 (continued)

Factors	Items	Loading	alpha
Radical innovation	13. develops new products which have completely new functions in market	0.741	0.77
	14. conducts product innovations by frequently introducing new technologies	0.791	
	15. conducts process innovations by introducing completely new technologies in the industry	0.764	
	16. conducts process innovations based on breakthrough concepts	0.781	
Incremental innovation	17. develops new products with some new style and services in the market	0.679	0.66
	18. conducts process innovation by frequently modifying and improving the firm's existing technologies	0.837	
	19. conducts innovations by improving current products and processes based on current knowledge	0.790	
Firm performance	20. increasing rate of sales revenue	0.898	0.85
	21. increasing rate of profit	0.926	
	22. increasing rate of ROI	0.876	
	23. increasing rate of market share	0.661	

Generally, the item's loading should not be less than 0.4. In Table 9.2, all loadings are greater than 0.4. Although the Cronbach alpha of incremental innovation is 0.66 (lower than 0.70), all item loadings are more than 0.68. Thus the reliability of incremental innovation should not be a concern (Li & Atuahene-Gima, 2001). Table 9.3 presents the descriptive statistics of all factors generated from our measurement model, including the means, standard deviations and correlations.

Table 9.4 summarizes the structural fitness statistics. The χ^2 of our structural equation model is 177.412. The goodness-of-fit index (GFI) is 0.928, which is larger than the commonly accepted 0.9. The adjusted goodness-of-fit index (AGFI) is 0.885; the incremental fit index (IFI) 0.998; the normed fit index (NFI) 0.933; the Tucker–Lewis index (TLI) 0.997; the comparative fit index (CFI) 0.998; and the root mean square error of approximation (RMSEA) 0.013, lower than the commonly accepted level of 0.05. These show that the fit statistics of SEM are acceptable. Table 9.5 summarizes the results of our hypothesis testing.

Table 9.3 Descriptive statistics

Variables	Mean	S. D.	1	2	3	4	5	6	7
1. Material reward	4.63	1.04	1.00						
2. Non-material reward	4.93	1.01	0.61**	1.00					
3. Output control	4.94	1.14	0.42**	0.49**	1.00				
4. Process control	5.34	1.16	0.47**	0.58**	0.73**	1.00			
5. Radical innovation	3.81	1.53	0.12	0.18*	0.09	0.15*	1.00		
6. Incremental innovation	4.30	1.37	0.11	0.22**	0.17*	0.21**	0.64**	1.00	
7. Firm performance	3.51	1.92	−0.89	−0.07	−0.05	−0.04	0.17*	0.11	1.00

Note: N = 194; significance level: * $p < 0.05$; ** $p < 0.01$.

Table 9.4 Structural fitness test

Indicator	Desired value	Value
χ^2	—	177.412
P	>0.05	0.373
GFI	Near or greater than 0.9	0.928
AGFI	Near or greater than 0.9	0.886
RMSEA	<0.035	0.013
Incremental fit index(IFI)	Near or greater than 0.9	0.998
Normed fit index (NFI)	Near or greater than 0.9	0.933
Tucker–Lewis index (TLI)	Near or greater than 0.9	0.997
Comparative fit index (CFI)	Near or greater than 0.9	0.998

Table 9.5 Summary of hypothesis testing

Hypothesis	Description of path	Standardised pathcoefficient	P-value	Conclusion
H1	Material reward → radical innovation	−0.549*	0.021	supported
H2	Material reward → incremental innovation	−0.279	0.149	not supported
H3	Non-material reward → radical innovation	0.597*	0.021	supported
H4	Non-material reward → incremental innovation	0.605*	0.022	supported
H5	Output control → radical innovation	−0.368*	0.032	supported
H6	Output control → incremental innovation	0.483*	0.026	supported
H7	Process control → radical control	0.383*	0.042	supported
H8	Process control → incremental innovation	−0.565*	0.047	supported
H9	Radical innovation → firm performance	0.541**	0.002	supported
H10	Incremental innovation → firm performance	−0.356*	0.042	supported

Note: Significance level: * $p < 0.05$; ** $p < 0.01$.

Organizational rewards and firm innovation

The first set of hypotheses (Hypotheses l–4) predicts the effects of organizational rewards on firm innovations. Hypothesis 1 argues that the material reward is negatively associated with radical innovation in Chinese technology firms. This hypothesis received strong empirical support (-0.549, $p < 0.05$). Hypothesis 2 claims that the material reward is positively associated with incremental innovation in Chinese technology firms. This hypothesis was not supported ($p > 0.10$). Hypothesis 3 predicts that non-material reward is positively associated with radical innovation in Chinese technology firms. This hypothesis was strongly supported (0.597, $p < 0.05$). Hypothesis 4, which predicts a positive relationship between non-material reward and incremental innovation, was also supported (0.605, $p < 0.05$). That is, for Chinese technology firms, the use of non-material reward can enhance both radical and incremental innovations.

Organizational controls and firm innovations

The second set of hypotheses (Hypotheses 5–8) predicts the effects of organizational controls on firm innovations. Hypothesis 5 posits that output control is negatively associated with radical innovation in Chinese technology firms. This hypothesis received strong support (-0.368, $p < 0.05$). Hypothesis 6, predicting a positive relationship between output control and incremental innovation, was also supported (0.483, $p < 0.05$). Hypothesis 7 claims that process control is positively related to radical innovation. This hypothesis was supported (0.383, $p < 0.05$). Hypothesis 8, which predicts a negative relationship between process control and incremental innovation, was also supported (-0.565, $p < 0.05$). These results suggest that, in Chinese technology firms, the focus on process control can enhance radical innovation, while the emphasis on output control can advance incremental innovation.

Firm innovations and long-term performance

Hypotheses 9 and 10 predict the effect of firm innovations on long-term financial performance. Hypothesis 9 predicts that radical innovation is positively related to a firm's long-term performance; this hypothesis was strongly supported (0.541, $p < 0.01$). Hypothesis 10, arguing for a negative relationship between incremental innovation and a firm's long-term performance, was also supported (-0.356, $p < 0.05$). The results show that it is radical innovation, not incremental innovation which can help Chinese technology firms to achieve better long-term financial performance.

DISCUSSION AND CONCLUSION

With a sample of technology firms in China, in this study we examined the effects of organizational reward and control on different types of firm innovations and further firm performance. There are several interesting findings. First, our results indicate that, in Chinese technology firms, material reward has a negative relationship to radical innovation; on the contrary, non-material reward promotes both radical and incremental innovations. Such findings are consistent with the results reported by Amabile and her colleagues (Amabile, 1983; Amabile *et al*., 1986; Hennessey & Amabile, 1998), but contrary to the conclusions of Baer (1997) and Eisenberger & Cameron (1996). It seems that, in technology-intensive industries which involve high levels of risks and uncertainties for innovation, non-material rewards are more likely to motivate employees to take risks and engage in firm innovations (including both incremental and radical). As we noted earlier, Chinese culture places a significant emphasis on face/reputation rather than financial possession. Thus, compared with financial possession, social acceptance and self-development offered by non-material rewards can make innovating employees in Chinese technology firms more fulfilled.

Consistent with our hypotheses, the second group of findings shows that process control in technology firms can encourage radical innovation, but discourage incremental innovation, while output control may encourage incremental innovation but discourage radical innovation. These results show that process control and output control play differential roles in a firm's innovation process. It seems that well designed process control mechanism can inspire employees to work on the significant product or technology innovations which need a long time to enter the market and earn returns (Goold & Campbell, 1987; Hoskisson *et al*., 1991). By implementing process control, top managers share responsibilities for innovation, and employees can expect their efforts to be valued. For technology firms in the Chinese transition economy, developing radical innovations is more difficult and risky than it is in developed economies. Thus process control becomes more critical for radical innovations in this context. However, output control can lead to incremental innovations. Since output control shifts substantial innovation risks to the innovating employees, employees are more likely to conduct incremental innovations when the output control is utilized.

The third group of findings is that, in Chinese technology firms, radical innovations can enhance firms' long-term financial performance, but incremental innovations may damage their long-term performance. These results show that technology firms' highly different radical innovations can help create high barriers for existing competitors and potential new entrants. This helps firms to maintain their competitive advantage and then

advance long-term performance. Technology firms can survive through incremental innovations in the short run, but, in the long run, technology firms which depend on incremental innovations will be driven out of the market in the rapidly changing technological environment. Our results demonstrate that, for technology firms, not all innovations are critical for firms' long-term performance. While radical innovations can advance a firm's long-term performance, incremental innovations may decrease the firm's long-term performance.

Our study contributes to the literature in several regards. First, by making a distinction between radical and incremental innovations, we examined how material rewards and non-material rewards may have different effects on incremental and radical innovations. As noted earlier, while some researchers have shown that material rewards can encourage innovation, others have disclosed opposite evidence. Our study advanced this literature by suggesting that material reward may be detrimental to radical innovation but may have no relationship to incremental innovation. Thus our findings highlight that, without specifying the nature of innovation type, the linkage between reward mechanisms and innovation cannot be theoretically developed.

Second, our study also contributes to the organizational control literature. Although prior research has argued that control mechanisms may have some relationships to innovation (Hitt *et al*., 1996), the ways in which different control mechanisms affect various types of firm innovation are not clear. The study presented here disaggregates control mechanisms and firm innovations and provides unique empirical findings because they represent, we believe, the first evidence in the management literature on the linkages between organizational controls and firm innovations. Our results add to this line of research by showing that process control and output control play different roles in effecting radical innovation and incremental innovation.

Third, by differentiating incremental and radical innovation, we were also able to offer an in-depth analysis of the way different types of firm innovations affect firm performance, particularly long-term financial firm performance. Our results show that, in Chinese technology firms, radical innovations are positively related to firm long-term performance while incremental innovations are negatively related to firm long-term performance. These findings send a strong message to managers in technology firms that, to maintain their sustainable competitive advantages, it is important for their firms to focus on radical innovations rather than incremental innovations.

Finally, we believe that this is the first empirical study which has systematically examined the relationship between organizational rewards/control mechanisms and firm innovations in the context of technology firms in

China's emerging market. Note that our theoretical model is built upon theories developed from the Western market economies (such as the US). By applying this model to China, we found evidence to support the model. However, rather than saying that our study has extended the Western literature to the Chinese context, we believe that research of this kind would enrich our understanding of the nature of rewards/control–innovation linkage across different institutional contexts.

Limitations and Future Research

Despite the implications and contributions to the relevant literature, this study has several limitations that open up future research avenues. First, as discussed earlier, our results can be biased by the sample, in which more than 40 per cent of the sample firms are from the electronics industry. Also, to improve the generalizability of our findings, future research should build on these results and examine the relationship between organizational rewards and controls and firm innovations in low-technology industries. It would be interesting to examine how the relationships we demonstrated here may differ between high-technology industries and low-technology industries.

Second, the use of self-report data may pose such potential problems as the limited recall of the respondents, biased perceptions of past realities, and common method issues. However, we took several actions during data collection to improve both the reliability and the validity of the retrospective reporting. Our post hoc examination and validation analysis indicated no serious common method problems.

Finally, the cross-sectional data used in the study do not allow for causal interpretations among the variables. Nor do they allow us to examine the 'dynamic' nature of the relationships we examined here. Future studies can benefit from a longitudinal research design. In conclusion, organizational rewards and controls can exert important effects on a firm's innovations and further financial performance. We expect this study to serve as a starting point for further efforts in enriching the understanding of the relationship between organizational rewards and controls, firm innovations, and performance in the context of transition economies.

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