

Does transformational leadership facilitate technological innovation? The moderating roles of innovative culture and incentive compensation

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Abstract The present research investigates the relationships between SBU-level transformational leadership and technological innovation, as well as the moderating effects of innovative culture and incentive compensation. Paired data were gathered from 102 senior managers and 258 employees in 102 Taiwanese strategic business units (SBUs). The results indicate that transformational leadership behaviors promote technological innovation at the SBU level. Interestingly, a stronger innovative culture is a substitute for transformational leadership behavior for facilitating technological innovation. In addition, financial-incentive adoption neutralizes the relationship between transformational leadership and technological innovation.

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Asian companies have had a profound effect on world markets. In many respects they have reshaped globalization through their explosive growth, by having the fastest-growing consumer markets, and through their enormous manufacturing output. Leadership, which facilitates innovation and competitiveness, is important to sustaining growth in Asian markets under the global pressure to constantly innovate. Today's business reality has shifted from "West leads East" to "West meets East" (Chen & Miller, 2010), and in this context, Asian leaders are striving to find a unique position from which they can outperform international rivals in the global market.

Effective leaders competing in turbulent environments play a particularly important role in helping firms enhance performance (Ireland & Hitt, 2005). Transformational leadership has been considered more effective than other leadership styles in facilitating organizational innovation because it targets change and innovation (e.g., Howell & Avolio, 1993; Lowe, Kroeck, & Sivasubramaniam, 1996). This stream of research has attracted increased attention in empirical studies (e.g., Elenkov, Judge, & Wright, 2005; Jung, Chow, & Wu, 2003; Jung, Wu, & Chow, 2008). Yet, most have examined general innovation at the firm level rather than specific types of innovation, such as technological innovation at the strategic business unit (SBU) level (Jung, 2001), which generally explains better the internal knowledge, practices, capabilities, cultures, and innovation outcomes (Tsai, 2001). Further, previous empirical studies examining the relationships between transformational leadership and unit innovation have been scarce and yielded contradictory results (Eisenbeiss, Knippenberg, & Boerner, 2008). For example, Keller (2006) found positive effects of transformational leadership on unit innovation performance; however, Jaussi and Dionne (2003) found a negative effect. This study fills these voids by investigating the influence of transformational leadership on technological innovation at the SBU level.

The rationale of specifically focusing on technological innovation includes, first, it is generally a bottom-up process and operations (Bantel & Jackson, 1989) that is driven by employees in the lower levels of an organization (Amabile, 1998; Menzel, Aaltio, & Ulijn, 2007). Transformational leaders play an essential role in nurturing a psychologically secure environment and setting the tone for such innovation to blossom. Second, technological innovation drives most organizations and directly affects firm performance (Zhou, Yim, & Tse, 2005); our focus on technological innovation rectifies the criticism that prior studies examine only indicators such as R&D expenditure, number of patents, and new product announcements (Tidd, 2001).

Leadership behaviors exist within the context of organizations, therefore it is crucial to clarify how situational moderators amplify or limit the effectiveness of transformational leadership in facilitating innovation. (Damanpour, 1991; Elenkov et al., 2005; Gumusluoglu & Ilsev, 2009; Howell & Avolio, 1993; Jung et al., 2003; Jung et al., 2008; Pawar & Eastman, 1997; Xenikou & Simosi, 2006). Several scholars suggest that the situational variables can be identified as enhancers, neutralizers, or substitutes of a leader's behavioral influence (Howell, Dorfman, & Kerr, 1986; Kerr & Jermier, 1978; Podsakoff, MacKenzie, & Bommer, 1996). By focusing on how moderators operate, managers can identify organizational situations that

facilitate greater innovation outcomes. Oke, Munshi, and Walumbwa (2009) proposed two boundary conditions of leader's influence on innovation; that is, create an environment where innovation thrives (e.g., an innovative culture) and provide key resources or standard policies (e.g., incentive systems to reward innovative efforts) that nurture innovation. In other words, innovative outcomes are more likely to occur when organizational culture supports innovation and when innovative behavior is rewarded (Wei, Liu, & Herndon, 2011; West, 2002). As a result, this study examines the moderating effects of innovative culture and incentive compensation on the transformational leadership–technological innovation relationship.

Taiwan presents an ideal context for exploring Asian leadership and innovation with the following characteristics. First, Taiwan has been a major intersection in the East-meets-West network, insofar as the island has had fifty years of Japanese colonization, has responded to the heavy influence of the post-war US economic model, and has undertaken its own development to become a key player in the worldwide electronics supply chain during the last few decades. Successful corporate leaders in Taiwan have tried to incorporate the strengths of both Western and Eastern management approaches as a way to embrace innovation. Second, transformational leaders, such as Stan Shih (the founder of the Acer group) and Cher Wang (the founder of HTC) (Lin & Hou, 2010) have shown how to effectively lead manufacturers in Taiwan down the path to progress from an OEM (original equipment manufacturing) contractor, to an ODM (original design manufacturing) partner, and then to an OBM (original brand manufacturing) global brand company. While the key success factor is rooted in Taiwanese manufacturers' ability to employ on-going new product and process innovation (Tseng & Goo, 2005), transformational leaders play a crucial role in facilitating the innovation that provides companies with sustainable competitive advantage. Further, they can infuse innovation activities into the corporate culture and business systems that can more effectively promote industrial transformation (Luo & Chang, 2011). Thus, it is appealing to examine the effect of innovation culture and incentive systems on the transformational leadership–technological innovation relationship for shedding some light on Taiwan and other economies that aspire to excel in technology innovation.

Third, Taiwan has made substantial investments in upgrading its innovative capabilities over the past decade (Porter & Stern, 2001). For example, the Innovation Development Report 2010–2011, released by the European Business School (EBS), ranked Taiwan ninth in the world and second in Asia (surpassed only by Singapore) in terms of innovative capacity. In addition, Taiwan's number of granted patents has been ranked number three in the world (Lopez-Claros, 2011). Finally, Taiwanese companies place significant emphasis on technological innovation (Lin & Chen, 2007), and Taiwan has effectively upgraded its economy to a high technology workshop (*Economist*, 2010). Therefore, Taiwan is an exemplary region for the study of technological innovation when both the East and the West are aware of the importance of sustaining competitiveness through innovation.

In summary, our study makes several contributions to theory and practice. First, we add to the literature of leadership by investigating the relationship between transformational leadership and technological innovation at the SBU level. Second, by examining the moderating effect of innovative culture on the transformational leadership–technological innovation relationship at the SBU level, we provide a more nuanced understanding of the role of transformational

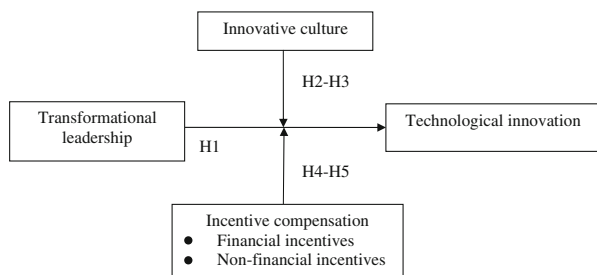
leadership and the role of innovative culture. Third, we identify the role of incentive compensation and provide insight into the differential moderating effects of financial versus nonfinancial incentives. These findings provide practical information for management decision-making. The proposed research framework is depicted in Figure 1.

Theory and hypotheses

Transformational leadership behaviors

Ever since Burns (1978) introduced the concept of transformational leadership, much research has examined the effectiveness of this leadership style (Avolio, Bass, & Jung, 1999; Bass, 1985; Podsakoff et al., 1996; Yukl, 2006) and how it assists top business executives to more effectively respond to rapidly changing environments (Bass, Avolio, Jung, & Berson, 2003). Transformational leaders are leaders who elevate followers' personal values and self-concepts, and who encourage followers to transcend their own self-interest for the sake of the organization (Bass, 1985; Jung, 2001). Numerous scholars have characterized transformational leadership as encompassing distinct components including charismatic influence, intellectual stimulation, idealized influence, inspirational motivation, articulating visions, providing appropriate models, fostering the acceptance of group goals, maintaining high performance expectations, and providing individualized support and individualized consideration (Bass et al., 2003; Howell & Avolio, 1993; Podsakoff et al., 1996). Subsequent research has found that some of these components are highly inter-correlated or similar to one another: for example, two notably related pairs are (1) charisma and idealized influence (Shamir, House, & Arthur, 1993) and (2) articulation of visions and fostering the acceptance of group goals (Podsakoff et al., 1996). Hence, most researchers have adopted the definition of Bass (1985), which features four main components: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. *Idealized or charismatic influence* represents the degree to which leaders are admired, respected, and trusted. *Inspirational motivation* means that leaders inject meaning and challenge into followers' work by articulating an attractive vision of the future. *Intellectual stimulation* refers to the degree to which leaders encourage followers to challenge existing assumptions, to reframe problems, and to approach old situations in new ways. *Individual consideration* involves paying

Figure 1 The proposed research framework



attention to followers' individual need for achievement and growth by acting as a coach or mentor.

Technological innovation

Technological innovation is related to changes in products, services, and production processes (Carmen & Maria Jose, 2008; de Castro, Verde, Sáez, & López, 2010). OECD (2006) asserted that the term "product" refers to both products and services. Industry leaders, such as HP and GE, integrate product offerings with service innovations to strengthen customer value (Shelton, 2009). Therefore, the present study defines "technological innovation" as encompassing product innovation, service innovation, and process innovation (OECD, 2006; Tidd, 2001), which can significantly improve production or distribution process (OECD, 2006). For example, production improvements cover features, product functions, modeling, material quality, and packing; innovative services include service content and attitudes; and process reengineering contains process reduction or combination, and innovative production (OECD, 2006; Tidd, 2001).

The effects of transformational leadership on technological innovation

In contrast to prior research that focuses on overall measure of innovation and fails to capture the specific characteristics of the innovations (Jasen, Vera, & Crossan, 2009; Jung et al., 2008), we believe that transformational leadership may enhance particularly technological innovation. For technological innovation, business units are required to change or improve product or service features to meet a market need and to improve the efficiency of product development and commercialization (Ettlie, Bridges, & O'Keefe, 1984). By creating and communicating a vision of customer orientation, transformational leaders can provide inspirational motivation to empower followers to act on the vision to foster technological innovation (Liaw, Chi, & Chuang, 2010; Narver, Slater, & Tietje, 1998). Specifically, in the highly interdependent technology innovation process (Dean & Snell, 1991), transformational leaders are instrumental in articulating an appealing vision of shared commitment (Eisenbeiss et al., 2008) and collective interests to increase followers' intrinsic motivation. Research shows that employees will thus attach high importance to team membership and engage in improving internal production efficiency for the sake of the team (Bass & Riggio, 2006).

Based on market information and customer needs, transformational leaders are in a position to point out different and new perspectives as intellectual stimulus to prompt followers to adopt an exploratory thinking style and an innovative approach in their work (Bass, 1985). Transformational leaders also serve as role models in displaying unconventional and creative behaviors to enhance followers' innovative behaviors through idealized influence (Howell & Higgins, 1990). Furthermore, transformational leaders not only focus on developing, coaching, and mentoring their followers but also regard followers as internal customers and align their individual interests with the overall organizational vision (Waldman & Bass, 1991). In line with the social exchange perspective (Blau, 1964), employees will reciprocate with more creativity and ideas for technological innovativeness to respond to their leaders' individualized

consideration. Consequently, when transformational leaders are able to use their idealized influence, provide individual consideration, inspirational motivation, and intellectual stimulation to employees, higher technological innovation may be generated. Thus, we hypothesize:

Hypothesis 1 Transformational leadership behaviors are positively associated with technological innovation at the SBU level.

Situational moderators

Kerr and Jermier's (1978) "substitutes for leadership" model and Howell et al.'s (1986) typology of moderators point to at least three types of situational moderators: enhancers, neutralizers, and substitutes. Enhancers represent a positive moderating influence (the stronger the enhancer, the stronger the predictor–criterion relationship), while neutralizers represent a negative moderating influence (the stronger the neutralizer, the weaker the predictor–criterion relationship). Enhancers and neutralizers are similar insofar as they influence the effect of a specific leadership behavior on criteria, but not the criteria themselves (Howell et al., 1986). Podsakoff, MacKenzie, and Fetter (1993) argued that a variable must satisfy the following conditions to qualify as a substitute for leadership: (1) the leader behavior must have a significant main effect; (2) the potential substitute variable must weaken the relationship between the leader behavior and the criterion variable; and (3) the substitute must have a significant main effect on the criterion variable in the same direction as the leader behavior's main effect. In the current study, we examine the types and the effects of two situational moderators namely, innovative culture and incentive systems on the relationship between transformational leadership and technological innovation.

Organizational culture and transformational leadership have been theoretically and empirically linked to organizational effectiveness; nevertheless, prior research has focused mainly on the Western context (Naranjo-Valencia, Jimenez-Jimenez, & Sanz-Valle, 2011), and has neglected to test interaction effects of innovative culture (Xenikou & Simosi, 2006) as well as different levels of analysis, such as the SBU level (e.g., Jung et al., 2008; Sarros, Cooper, & Santora, 2008). Consequently, we have little basis for answering the question of whether prior findings also hold in the Eastern context. In conducting this research in Taiwan, this study helps to fill these gaps.

Different types of incentive compensation have different effects on workplace outcomes, including employees' behavior (Bandura, 1986; Stajkovic & Luthans, 2001). Extant leadership and innovation literature focuses more on top managers' compensation or CEO pay, little empirical research explores the effects of employee incentive compensation on the enhancement of organizational innovation. Therefore, in addition to innovative culture, the moderating effect of incentive compensation is also examined in this study.

Innovative culture as an enhancer

"Organizational culture" can be defined as the personality of the organization as well as the SBU, which is composed of the assumptions, values, beliefs, attitudes, and

behaviors of organizational members (Schein, 2004). Organizational contextual factors, such as organizational culture, help amplify the effect of transformational leadership by increasing individuals' receptivity to an articulated vision and new values, and to the collective interest (Pawar & Eastman, 1997; Pittigrew, Ferlie, & McKee, 1992). An innovative culture at the SBU level embraces innovation, growth, and new resources, and highly values flexibility, adaptability, creativity, risk taking, and entrepreneurship (Deshpande, Farley, & Webster, 1993; O'Cass & Viet Ngo, 2007). Since innovation typically requires long-term investments and risk-taking, employees need to perceive that the SBU promotes openness to new ideas and cultivates internally based capabilities in the adoption of new ideas, processes, or products (Hurley & Hult, 1998). Such innovative culture encourages employees to get involved in the complicated technologies underlying new product development for the marketplace (Gatignon & Xuereb, 1997).

Leaders who need to inspire followers to accomplish more difficult innovation outcomes, solve problems during the technological innovation operation process, and develop subordinates to higher levels of innovative capabilities, are likely to find that organization members are more receptive to these aims when an innovative culture has been established within the SBU (Bass, 1985). Accomplishing these aims creates a need for transformational leadership. SBUs with a relatively low level of innovative culture and a lack of autonomy, freedom, and flexibility hinder employee creativity (Naranjo-Valencia et al., 2011). A low innovative culture further decreases organizational receptivity to transformational leadership because receptivity is a function of the extent to which the context shows openness or responsiveness to change (Pawar & Eastman, 1997). In such a less receptive context, transformational leadership may fail to generate innovation commitment of organizational members, no matter how appealing and appropriate the vision (Avolio & Bass, 1988). In sum, a high innovative culture is more conducive to transformational leadership while the absence of an innovative SBU culture makes it more difficult for the transformational leader to stimulate employee willingness and efforts towards technological innovation. In this sense innovative culture can be seen as an *enhancer* (e.g., Howell & Avolio, 1993; Jung et al., 2008). Thus, we propose that:

Hypothesis 2 Innovative culture enhances the effect of transformational leadership on technological innovation at the SBU level, such that the effect of transformational leadership on technological innovation will be stronger when the level of innovative culture is higher.

Innovative culture as a substitute

Although innovative culture may play a role as an enhancer, which represents a positive moderating effect on leadership's effect on innovation, we postulate another perspective regarding the role of innovative culture in SBUs that affects the aforementioned relationship. According to the definition provided by Howell et al. (1986), enhancers are moderators which augment relationships between leader behaviors and criteria, but they have little or no influence on the criteria themselves. Nevertheless, they also suggest that an innovative culture also has a direct influence on innovation outcomes in organizations (e.g., Jimenez-Jimenez, Sanz Valle, & Hernandez-Espallardo, 2008;

Martins & Terblanche, 2003; McLean, 2005). This leads to the question, “Does innovative culture act as a *substitute* for transformational leadership when SBUs pursue the strategy of technological innovation?” Several researchers (e.g., Sergiovanni, 1992; Tichy & Sherman, 1993) have suggested organizational culture and values as substitutes for leadership effects because employees who share organizational values have little need for supervision (Podsakoff & MacKenzie, 1997).

The effects of culture may be even stronger at the SBU level. As Tosi and Banning (1998) noted, social controls, norms, and values may have their strongest effects on performance at the group level. Culture at the group level provides a more immediate and engaging work context for group members, where particular values and attitudes get formed and are routinely reinforced (Lok, Westwood, & Crawford, 2005). In addition, these group values and norms can also influence perceptions, attitudes, and behaviors of employees to a greater extent than culture at the organizational level (Harris & Ogbonna, 1998). Thus, the strength of the impact of the shared values and norms embedded in innovative culture at the SBU level may serve to substitute for transformational leadership.

Innovative culture in business units is a kind of subculture, which forms around organizational groups on the basis of a range of factors such as location, functional focus, and professional background (Bloor & Dawson, 1994). Subcultures are not necessarily consistent with the main organizational culture (Hofstede, 1998). Instead, subcultures provide a more focused and coherent basis for identification than the main organizational culture (Harris & Ogbonna, 1998; Lok et al., 2005). Innovative culture in SBUs provides more stimulating and engaging environments for experimentation, risk, challenge, and creativity than the main organizational innovative culture (Wallach, 1983). A strong innovative culture can build norms and routines for SBU members to continuously invest innovation efforts for product and process innovations. This implies that innovative SBU cultures can help create SBU members’ consistent perceptions of an innovative cultural orientation, thus serving as a guideline for SBU members when facing challenges affecting technological innovation outcomes.

Podsakoff et al. (1996) suggested that the presence of substitutes can lessen the need for leader intervention and let an astute leader adapt his behaviors to other strategic actions, such as more time on determining the firm’s purpose and vision, exploiting and maintaining core competence, developing human capital, emphasizing ethical practices, and establishing balanced organizational controls (Ireland & Hitt, 2005). Following this logic, we propose the following hypothesis regarding the role of innovative culture as a substitute for leadership.

Hypothesis 3 Innovative culture substitutes for the effect of transformational leadership on technological innovation at the SBU level, such that the effect of transformational leadership on technological innovation will be weaker when the level of innovative culture is higher.

Incentive compensation systems

Compensation systems specify the contributions that an organization expects from its members and express not only values and norms to which those in the organization

must conform but also the responses that individuals can expect to receive as a result of their performance (Kerr & Slocum, 2005). The literature on incentive-compensation systems covers two aspects—financial and non-financial incentives. Financial incentives (e.g., bonuses, variable pay, and stock options) increase the pressure to perform better, and non-financial incentives (e.g., feedback, challenging work, difficult goals, and task interdependence) also have been found to motivate performance (Fey & Furu, 2008). Porter and Lawler's (1968) model proposes that firms can foster effective performance by creating both extrinsic and intrinsic rewards. They also report that the combined incentives yielded greater work outcomes (Gagné & Deci, 2005; Wiersma, 1992). Consequently, most employers in Western companies use both financial and non-financial incentives to boost motivation and performance (Huff, 2006).

The underlying objective of an incentive program is to directly influence the actions and behaviors of those employees covered under the program. Performance-based or output-based financial rewards have been found to have a positive effect on innovation performance (e.g., Balkin, Markman, & Gomez-Mejia, 2000; Laursen, 2002; Laursen & Foss, 2003) and technological innovations (Cabrales, Medina, Lavado, & Cabrera, 2008), yet little or no attention has been paid to whether financial or non-financial incentives differ from each other in their effects on employees' behavior (Bandura, 1986; Stajkovic & Luthans, 2001). Our research examines the effects of financial and non-financial incentive systems separately at the employee level rather than the top managerial level.

Financial incentives as a neutralizer Although performance-based financial incentives have been found to have a positive effect on innovation performance (e.g., Balkin et al., 2000; Laursen, 2002; Laursen & Foss, 2003), another school of thought posits that the effects of extrinsic rewards can be detrimental to individual outcomes such as creativity, cognitive flexibility, and problem solving for they are related to intrinsic motivation (Amabile, Goldfarb, & Brackfield, 1990; Deci, Koestner, & Ryan, 1999). The rationale is rooted in cognitive evaluation theory which suggests that external factors such as tangible rewards, competition, deadlines, and evaluations tend to diminish feelings of autonomy and undermine intrinsic motivation (Gagné & Deci 2005). Erez, Gopher, and Arzi (1990) supported this argument and indicated that monetary rewards decreased performance on a complex task with difficult goals.

When a firm regards extrinsic rewards, like financial incentives, as a main reward system to motivate employees to enhance innovation activities, such an incentive system may ignore those employees' preferences for intrinsic-motivation factors, such as job autonomy and achievement, and then diminish their efforts of technological innovation adoption. Indeed, a system of financial incentives is more appropriate for transactional leaders' efforts rather than transformational leaders to foster innovation because transactional leadership based on contingent rewards involves the clear delineation of expectations and goals on the part of a leader, as well as what followers can expect in the way of rewards if they cooperate (Avolio et al., 1999; Waldman & Bass, 1991). Thus, we propose that financial rewards will *neutralize* the relationship between transformational leadership behaviors and technological innovation outcomes.

Hypothesis 4 Financial incentives in compensation systems neutralize the effect of transformational leadership on technological innovation at the SBU level, such that the effect of transformational leadership on technological innovation will be weaker when the level of financial incentives is higher.

Non-financial incentives as an enhancer Although financial incentives can be an extrinsic motivator, when withheld they become a punishment. Yet, non-financial incentives in organizations are most closely associated with recognition (Peterson & Luthans, 2006), and can be a powerful intrinsic motivator for performance improvement (Stajkovic & Luthans, 2003).

According to self-determination theory, basic psychological needs for competence and autonomy are central features in facilitating intrinsic motivation (Deci & Ryan, 1985; Ryan & Deci, 2000). Research shows that an autonomy-supportive context enhances intrinsic motivation which provides greater choice, encourages self-initiation, and is exactly the context that transformational leadership fosters (Gagné & Deci 2005; Ryan, Mims, & Koestner, 1983).

In contrast to transactional leadership, non-financial incentives are the focus of transformational leadership. Rather than focusing solely on extrinsic motivators, transformational leaders direct their attention to mentoring, developing, and empowering their followers to perform beyond expected levels, thus fostering intrinsic work motivation and a sense of mission (Howell & Avolio, 1993; Mosley & Patrick, 2011). To pursue technological innovation, transformational leaders articulate a compelling vision of the benefits derived from the technological innovation and augment the value of employees' involvement in product and process innovations. Transformational leaders effectively use non-financial incentives including support, providing feedback, recognition and development to better motivate employees and increase their innovative performance (Iles, 2001; Nelson, 2001). Accordingly, non-financial incentives act as an *enhancer* in the linkage between transformational leadership and technological innovation at SBUs. Thus, we propose:

Hypothesis 5 Non-financial incentives in compensation systems enhance the effect of transformational leadership on technological innovation at the SBU level, such that the effect of transformational leadership on technological innovation will be stronger when the level of non-financial incentives is higher.

Methodology

Sample and data collection

Our research sample targeted Taiwanese SBUs regarding the relationships among transformational leadership, innovative culture, incentive compensation, and technological innovation. SBUs are the unit of analysis in this study. SBUs are profit centers, which have their own strategy and objectives to perform, and are responsible for performance in one or more target markets. Employees are more likely to be acquainted with the strategies, processes, management, and performance of the SBU than those of the entire company (Narver, Slater, & MacLachlan, 2004). For the current study, we have used

purposive sampling, targeting SBUs for whom technological innovation is important. We contacted 390 Taiwanese-owned SBUs. To avoid the problem of common method variance (CMV), we used separate surveys to gather data for independent and dependent variables. Each survey package contained one senior manager questionnaire and three questionnaires for employees. In each SBU, the senior manager was asked to answer the degree of the technological innovation adoption, and employees were asked to answer the questions concerning transformational leadership behaviors attributable to the senior managers, the organizational culture orientation, and the incentive compensation for innovation. Useable paired data were gathered from 102 senior managers and 258 employees in 102 Taiwanese SBUs. The response rate was 26.15 percent and 22.05 percent for senior managers and employees, respectively.

Average SBU size was 909 employees, average age of the SBUs was 19.18 years, and 94.4 percent of the SBUs were privately owned. Seventeen percent of the SBUs in our sample were in the business of producing consumer products, 30 percent provided consumer services, 36 percent produced industrial products, and 17 percent provided industrial services. In addition, the ANOVA test showed a non-significant variance between different business areas for technological innovations (product innovation, $F = 1.19$, n.s.; process innovation, $F = .95$, n.s.; technological innovation, $F = 1.04$, n.s.). Therefore, we combined these SBUs from different business areas for further analysis.

Measures

The [Appendix](#) lists the scale items for measures used in the study except for control variables.

Dependent variable

Technological innovation In this study, we examined product and process innovation to measure technological innovation. The measurement is derived from Wang and Ahmed (2004). Participants were asked to respond to two items each for product and process innovation on a seven-point scale (1 = strongly disagree and 7 = strongly agree). Although factor analyses support the distinctiveness of product and process innovation, nevertheless, the two factors are significantly correlated ($r = .356$, $p < .001$). Since Tornatzky and Fleischer (1990) concluded from their research that process and product innovations may drive and complement each other or occur simultaneously, we aggregated the four items into a composite index (with a Cronbach's alpha of .92) to indicate technological innovation outcomes at the SBU level.

Independent variable

Transformational leadership behaviors Empirical studies on the effects of transformational leadership usually use the Multifactor Leadership Questionnaire (MLQ) (Bass & Avolio, 1995); however, there have been some critiques of the psychometric properties of the MLQ (e.g., Antonakis, Avolio, & Sivasubramaniam, 2003; Tejada, Scandura, & Pillai, 2001; Tepper & Percy, 1994). One shortcoming of these prior reviews is that the four component behaviors of the MLQ have not been consistent from

study to study (Yukl, 2006). Antonakis et al. (2003) identified 14 studies that have generated conflicting claims regarding the factor structure of the MLQ and the number of factors. The cause of this problem may stem from the fact that the originally identified components are highly inter-correlated and have not always remained independent (Fu, Tsui, Liu, & Li, 2010). Therefore, instead of the MLQ, we have used the four items designed by Garcia-Morales, Matias-Reche, and Hurtado-Torres (2008) and Podsakoff et al. (1996) for measuring transformational leadership on a seven-point scale (1 = strongly disagree and 7 = strongly agree).

The rationale for adopting the model of Garcia-Morales et al. (2008) and using one item for each component of transformational leadership is four-fold: first, the measurement has been validated for technological companies; second, the scale focuses on perceptions of CEO transformational leadership; third, respondents should be able to clearly and easily identify the behavior of transformational leadership (e.g., McColl-Kennedy & Anderson, 2002; Fu et al., 2010); and fourth, several studies have empirically tested the four dimensions of transformational leadership (Bass & Avolio, 1994; Dubinsky, Yammarino, Jolson, & Spangler, 1995; Judge & Piccolo, 2004; McColl-Kennedy & Anderson, 2002).

We conducted a confirmatory factor analysis (CFA) using AMOS 5.0, and the maximum likelihood estimation for these four items. Data analysis showed that the one-factor model exhibited good fit ($X^2 = 1.95$; $p = .377$, NFI = .995, GFI = .990, CFI = 1.000, SRMR = .009). Thus, we combined all the transformational leadership items into an overall score.

Moderating variables

Innovative culture Our measure of innovative culture at the SBU level was drawn from the work of O'Reilly, Chatman, and Caldwell (1991), and the items were measured on a seven-point Likert scale (where 1 = strongly disagree and 7 = strongly agree). Our measure consists of three items: innovativeness, rapid exploitation of advantageous circumstances, and risk taking. The Cronbach's alpha was .87.

Incentive compensation We used two items each for financial and non-financial incentives drawn from the work of Bubshait (2003) and Appelbaum and Kamal (2000), based on four-point scales, (with 1 = least often adopted and 4 = most frequently adopted). The Cronbach's alpha for financial and non-financial incentive compensation was .61 and .67, respectively. Our data met the criterion for the internal consistency value higher than .60 (Malhotra, 2004). The level of our measure of reliability is supported by several prior studies including for example, Sherman and Smith (1984) who indicated that the respective Cronbach's alpha for financial and non-financial incentives was .65 and .60. Zhou, Zhang, and Montoro-Sanchez (2011) have even reported the Cronbach's alpha of financial rewards less than .60.

Control variables

We controlled for SBU size and age in this study because prior studies reported their positive relationship with organizational innovation (Elenkov et al., 2005; Jung et al.,

2003; Jung et al., 2008). SBU size refers to a log transformation of the total number of employees, and SBU age equals SBU tenure.

Aggregation analysis

To aggregate individual SBU employees' survey responses to SBU level, we first calculated inter-rater agreement following the formula developed by James, Demaree, and Wolf (1984) for transformational leadership, innovative culture, and incentive-compensation scales. For transformational leadership, the r_{wg} mean was .71 and the r_{wg} median was .87. For innovative culture, the r_{wg} mean was .67 and the r_{wg} median was .87. For incentive compensation, the r_{wg} mean was .82 and the r_{wg} median was .88. All r_{wg} values were above the conventionally accepted value of .60 (De Luca & Atuahene-Gima, 2007).

Next, we calculated intraclass correlation coefficients (i.e., ICC(1) and ICC(2) values) according to Bliese's (2000) suggestions. The ICC(1) values for transformational leadership, innovative culture, and incentive compensation were .56, .47, and .35, respectively. The ICC(2) values for transformational leadership, innovative culture, and incentive compensation were .99, .98, and .99, respectively. All the ICC(1) values reached the accepted value .12, and the ICC(2) values were all greater than .7, indicating acceptable reliability (Bliese, 2000). Therefore, our data aggregation was appropriate, confirmed by the r_{wg} , ICC(1), and ICC(2) values.

Results

Table 1 reports the means, standard deviations, and correlation coefficients for all independent and dependent variables. Transformational leadership had significant associations with non-financial incentives ($r = .274, p < .01$) and technological innovation ($r = .301, p < .01$). Innovative culture was significantly correlated with technological innovation ($r = .848, p < .001$). To look into the high correlation, we further conducted correlation analysis of items contained in innovative culture and

Table 1 Descriptive statistics and correlations among variables.

Variable name	Mean	Std.	1	2	3	4	5	6
1 SBU size ^a	4.79	1.92	–					
2 SBU age	20.75	20.91	.195†	–				
3 Transformational leadership	5.25	1.01	.118	.080	–			
4 Innovative culture	4.10	1.32	.185†	.132	.136	–		
5 Non-financial incentives	2.44	.59	–.051	–.050	.274**	–.090	–	
6 Financial incentives	2.29	.73	.007	–.104	.042	–.127	.206†	–
7 Technological innovation	4.12	1.26	.159	.069	.301**	.848***	.073	–.126

† $p < .1$; * $p < .05$; ** $p < .01$; *** $p < .001$.

^a SBU size is log-transformed.

technological innovation to examine discriminant validity, which means that measures of different constructs should share little common variance (Bagozzi & Phillips, 1980). The results showed that correlation coefficients among items of innovative culture and technological innovation were lower than the intercorrelations between innovative culture items and between technological innovation items. Thus, innovative culture and technological innovation are distinct from each other.

Hypothesis testing

We implemented hierarchical regression analysis to examine the direct effects of transformational leadership and the moderating effects of innovative culture and incentive compensation (i.e., financial and non-financial incentives). Following the recommendations of Aiken and West (1991), any variable used as a component of an interaction term is mean-centered. In Table 2, Model 1 concerns the effects of the control variables on technological innovation; in Model 2, the equation accounts for the main predictor (i.e., transformational leadership) in addition to the control variables; Model 3 presents the main effects of the moderating variables;

Table 2 Results of the moderated regression analysis for technological innovation.

Variables	Technological Innovation					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Controls						
SBU size ^a	.108	.082	-.055	-.094	-.117	-.121
SBU age	.126	.105	.008	-.045	.060	.057
Independent variables						
Transformational leadership		.258*	.169*	.136*	.126*	.153*
Moderating variables						
Innovative culture			.826***	.809***	.791***	.729***
Financial incentives			-.226	-.259	-.314	-.328
Non-financial incentives			.163	.188	.209	.234
Interactions						
Transformational leadership × Innovative culture				-.158*	-.174**	-.273*
Transformational leadership × Financial incentives					-.117†	-.139*
Transformational leadership × Non-financial incentives						.113
<i>F</i>	1.178	2.419†	32.615***	30.914***	28.256***	25.291***
<i>R</i> ²	.034	.099	.756	.777	.789	.791
ΔR^2	.034	.065*	.657***	.021*	.012†	.002

† $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

^a SBU size is log-transformed.

Models 4 through 6 involve the interaction terms used for testing the moderation effects of innovative culture, financial incentives, and non-financial incentives, respectively.

The results show that the proposed positive relationship between transformational leadership behaviors and technological innovation (Hypothesis 1) was supported ($\beta = .153, p < .05$). Hypotheses 2 and 3 posited the different moderating roles of innovative culture on the relationship between transformational leadership and technological innovation, including an enhancer and a substitute for leadership. The results indicate that innovative culture both was positively associated with technological innovation ($\beta = .729, p < .001$) and significantly weakened the positive effect that transformational leadership had on technological innovation ($\beta = -.273, p < .05$). Hence, Hypothesis 3 was supported, whereas Hypothesis 2 was not.

Hypotheses 4 and 5 concern the moderating effect of financial and non-financial incentives on the relationship between transformational leadership and technological innovation. As predicted, the interaction effect between transformational leadership and financial incentives was negatively related to technological innovation ($\beta = -.139, p < .05$). Hypothesis 4 was confirmed. Finally, although we posited that non-financial incentives would enhance the relationship between transformational leadership and technological innovation, the results show that the coefficient is positive but not significant ($\beta = .113, n.s.$). Accordingly, Hypothesis 5 was not supported.

Following Aiken and West's (1991) approach, we plotted the interaction forms to interpret significant moderated relationships. Figures 2 and 3 depict the interaction plot for the moderating role of innovative culture in the relationship between transformational leadership and technological innovation, as well as the interactive effect between transformational leadership and financial-incentive adoption on technological innovation. Figure 2 shows that the positive relationship between transformational leadership and technological innovation becomes weaker when the level of innovative culture increases. As shown in Figure 3, when the degree of financial-incentive adoption increases, the positive relationship between transformational leadership and technological innovation becomes weaker.

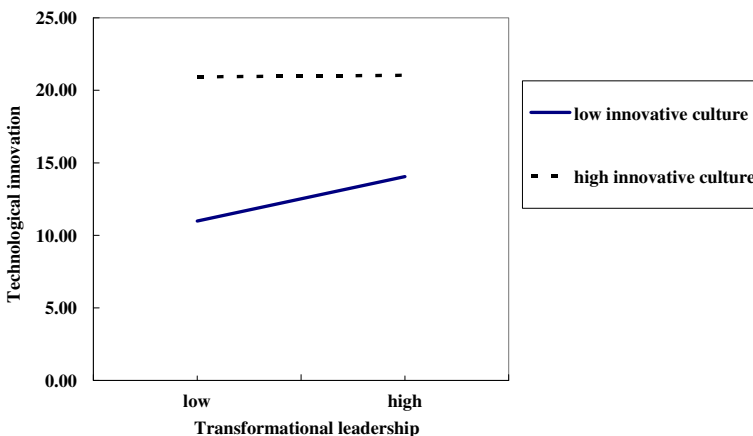


Figure 2 The moderating effect of innovative culture

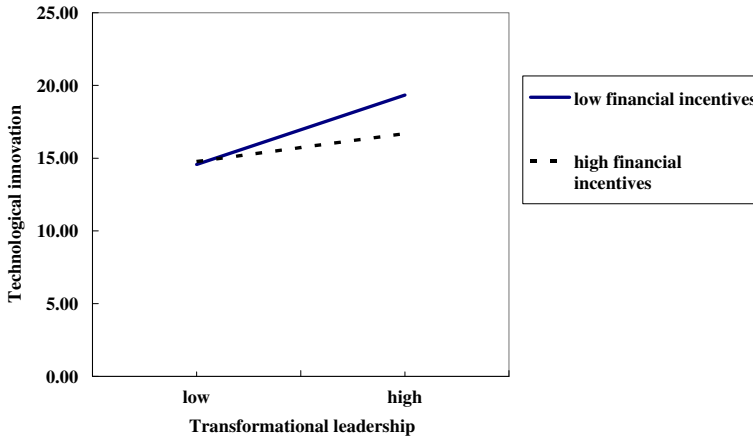


Figure 3 The moderating effect of financial incentives

Discussion and conclusions

In this study we investigated the effects of transformational leadership on technological innovation at the SBU level, as well as the moderating effects of innovative culture and incentive compensation. Our findings provide several theoretical and empirical contributions to extant leadership and innovation literature. In line with prior studies (e.g., Gumusluoglu & Ilsev, 2009; Jung et al., 2003; Jung et al., 2008), this study enriched transformational leadership research and found a significant positive influence on technological innovation at the SBU level. These results suggest that regardless of a Western or Eastern context, transformational leadership plays an important role in fostering innovation. Our results also indicate that transformational leadership is effective at the SBU level, adding support to Pittigrew et al.'s (1992) team-level study.

We sought to go beyond simply examining the situational moderators in the transformational leadership–technological innovation linkage, by further identifying three types of moderators (i.e., substitutes, neutralizers, and enhancers). As for the moderating role of innovative culture, this study examined both the enhancing and substituting effects of innovative culture, thus providing a more comprehensive picture of how transformational leaders impact technological innovation. Interestingly, contrary to prior research (e.g., Howell & Avolio, 1993; Jung et al., 2008), our findings lend support to the idea that strong innovative culture at the SBU level may substitute for transformational leadership behaviors. Typically, substitutes addressed in past research are associated with lower-level managerial positions instead of top managers' behavior (Dionne, Yammarino, Howell, & Villa, 2005). There is a need to create new substitutes related to top managers' leadership, and we assert that one such substitute may be innovative culture.

Numerous cross-cultural organizational studies suggest that cultural variables can play a role as an independent, dependent, or moderating variable in explaining an organizational phenomenon of interest in the Asian context (Bhagat, McDevitt, & Mcdevitt, 2010), with some studies indicating that the economic success of Asia is partially culture-driven (Ahlstrom, Chen, & Yeh, 2010; Liden, 2012). An organizational

culture is embedded in and significantly influenced by the national culture within which it is located (Sun, 2002), thus making it likely that Taiwan's culture and leadership practices reflect its Confucian values and are strongly influenced by Western culture and business practices (Liden, 2012; Resick, Martin, Keating, Dickson, Kwan, & Peng, 2011). Some empirical studies also reported that organizational culture in Taiwan combines emphasis on innovation, aggressiveness and respect for people, traits that are important for global competitiveness and sustainability (McKinnon, Harrison, Chow, & Wu, 2003; Silverthorne, 2004). Thus, our finding may reflect the influence of Asian culture on the contextual setting of our study; that is, SBU-level innovative culture may be an important substitute for leadership of fostering innovation in Asian SBUs.

Innovative culture is the critical predictor of innovation, one criterion for being a substitute for leadership (e.g., Aldas-Manzano, Kuster, & Vila, 2005; Eisenbeiss et al., 2008; Jimenez-Jimenez et al., 2008; Josephberg, Pollack, Victoriano, & Gitig, 2003). In addition, SBU-level innovative culture is one kind of subculture, and employees may perceive the innovative culture at the SBU level to be stronger than the main culture in the organization as a consequence of sharing the same values, norms, problems, and situations in business units. Innovative culture at the SBU level represents the signals that employees receive concerning SBU expectations for innovative and risk-taking behaviors related to improving modes of production and the delivery of existing products or services in order to increase efficiency and reduce costs. The higher the level of this kind of SBU culture, the less the need for innovation supervision from leaders.

Scholars advocate that transformational leadership behavior can induce significant influences on individual-level, team or group-level, and organizational-level outcomes (Wang, Oh, Courtright, & Colbert, 2011). For instance, leader's motivational and elevating effect on followers includes organizational citizenship behavior (e.g., Nahum-Shani & Somech, 2011), employee's well-being (e.g., Liu, Siu, & Shu, 2010; McKee, Driscoll, Kelloway, & Kelley, 2011), and employee's creative performance (e.g., Gong, Huang, & Farh, 2009). In addition, transformational leaders encourage team cohesion, facilitate cooperation and coordination among group members, and increase team performance and effectiveness (e.g., Bass et al., 2003; Hur, Van Den Berg, & Wilderom, 2011; Zhang, Cao, & Tjosvold, 2011). Furthermore, transformational leaders may influence organizational performance through their impact on organizational climates, systems, and strategies (Liao & Chuang, 2007). As Howell (1997) argued, substitutes may neutralize and replace one leader behavior and enhance one or more other behaviors. Thus, transformational leaders may spare their time for other tasks in addition to technological innovation efforts if SBUs have a strong innovative culture (Podsakoff et al., 1996).

Both extrinsic and intrinsic rewards are important sources of motivation, thus managers need to consider combining financial and non-financial incentives in order to more effectively facilitate innovation (Appelbaum & MacKenzie, 1996). However, financial and non-financial incentives also have different effects on innovation. Our results suggest that the adoption of financial incentives neutralized the relationship between transformational leadership and technological innovation with a negative moderating effect. This finding supports the contention of cognitive evaluation theory that extrinsic rewards might degrade the effects of intrinsic motivation when

followers perceived transformational leadership behavior. This suggests that the greater use of financial incentives will weaken the positive effects of transformational leadership on technological innovation in SBUs.

Unexpectedly, the moderating effect of non-financial incentives on the transformational leadership–technological innovation linkage was not significant. Employee perception may play a role here. Non-financial incentives in organizations are most closely related to recognition and performance feedback, the former allows the employees to realize that they were noticed, and the latter enables the employees to know how they were doing (Peterson & Luthans, 2006). Our survey items relay the message of goal-oriented freedom, responsibilities, professional development and recognition as non-financial incentives and preclude objective feedback information. Since technological innovation requires long-term employee efforts, performance feedback may be a more crucial non-financial incentive.

Practical implications

Our findings also have some practical implications for managers and decision makers in SBUs in Taiwan. First, Tseng and Goo (2005) argued knowledge-intensive industries will account for at least sixty percent of Taiwan's GDP within ten years through promoting technological innovation and development. To successfully promote technological innovation, our research shows that continuous cultivation and selection of transformational leaders at the business-unit level are required.

Second, we found that both leadership and culture facilitate SBU innovation performance in Taiwan. SBU members will be receptive to transformational leadership behaviors under an innovative culture; conversely, transformational leaders will be constrained by SBU culture characterized by rules, policies, and procedures (Pawar & Eastman, 1997). Since decisions and acts of leaders create an organizational environment, culture, and structure that may substitute for leadership (Dionne et al., 2005), we further suggest that investing in innovative culture building allows leaders to have more time for other strategic issues without jeopardizing the SBU's technological innovation.

Third, in Taiwan, most high-tech companies or businesses mainly offer shares or cash-based rewards to enhance innovation outcomes (Ho, Lai, & Tai, 2010) because innovation is high-risk investment with deferred compensation. For example, Taiwan Semiconductor Manufacturing Company (TSMC) attracts a large number of outstanding individuals to join them by offering stock bonuses. However, these business leaders ignore the fact that the greater use of financial incentives has the potential to weaken the leader's efforts to boost technological innovation outcomes; therefore, transformational leaders who are pursuing these outcomes should also place an emphasis on non-financial interventions, such as recognition and performance feedback.

Limitations and future research directions

While this study offers insight into the questions posed, it also has limitations. First, from a methodological perspective, it may be useful for future research to increase the number of respondents. While we found that the number of respondents did not

appear to influence the bias of r_{wg} , future research should consider using equally sized respondents larger than three. Second, although we avoided the CMV problem in gathering data from different sources, the cross-sectional design does not indicate causal relationships among transformational leadership, innovative culture, incentive compensation, and technological innovation. Longitudinal research should be empirically designed for the model thus enabling future research to suggest causal directions.

This research also suggests several possibilities for future leadership research in Asia. First, we provided new insights but a contradictory perspective that innovative culture might be a substitute rather than an enhancer for transformational leadership in the business context in Taiwan. Future research needs to investigate whether other types of subcultures beyond innovative culture at the SBU level act as a substitute for leadership in business units. It would also be important to examine how or whether an organization's main culture enhances or substitutes for leadership effect are also necessary to delineate. Second, as Dionne et al. (2005) suggested, the act of creating leader substitutes is a possible example of a mediated relationship at least over time. A leader can impact the level of innovative culture which in turn affects innovation outcomes. While we took innovative culture as a situational moderator in this study, future research is needed to probe more deeply into how innovative culture substitutes for leadership in SBUs, specifically studying the mediating role of innovative culture in the relationship between leadership and innovation. Third, we found one possible problem afflicting the measurement of non-financial incentives for technological innovation was a lack of performance feedback regarding innovative behaviors. Thus, future scholars should examine the influence of incentives based on rewarding innovation outcomes and innovative behavior on technological innovations, and the different effects of financial and non-financial incentives. Fourth, as an extension to our innovative culture, future research can examine models comparing moderating or mediating effect of various cultural dimensions between transformational leadership and technological innovation in Asia. Last, moderating influences of cultural variables, such as power distance, assertive cultures, paternalism and traditional values can be examined to explain the different findings of transformational leadership and outcomes relationship between Asian and Western countries (Dorfman & Howell, 1988; Liden, 2012).

Appendix

The question items of technological innovation, transformational-leadership behaviors, innovative culture, and incentive compensation

Technological Innovation

1. This SBU introduced more innovative products or services during the past three years than your major competitor (product innovation).
2. This SBU has been frequently bringing new products or services into the market during the past three years (product innovation).
3. This SBU introduced business processes of greater innovativeness during the past three years than your major competitor (process innovation).

4. This SBU has been frequently improving your business processes during the past three years (process innovation).

Transformational leadership behaviors

1. Our SBU's top leader will act as the leading force if we encounter dangers (idealized influence).
2. Our SBU's top leader paints a clear picture of the future vision (inspirational motivation).
3. Our SBU's top leader has stimulated me to think about old problems in new ways (intellectual stimulation).
4. Our SBU's top leader is capable of coaching me on the job (individual consideration).

Innovative Culture

1. We are energetic about being innovative in this SBU (innovativeness).
2. We are encouraged to try new things and to take advantage of opportunities in this SBU (rapid exploitation of advantageous circumstances).
3. We will be rewarded for our risk taking in this SBU (risk taking).

Incentive Compensation

Financial incentives

1. This SBU provides merit pay based on individual performance.
2. This SBU provides monetary incentive compensation but not salary or bonus compensation.

Non-financial incentives

1. This SBU provides considerable freedom and many responsibilities that challenge individual growth.
2. This SBU provides opportunities for professional development and industry recognition.

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