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The impact of leaders' technical competence on employees' innovation and learning

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A R T I C L E I N F O

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A B S T R A C T

The support of leaders plays a crucial role in enhancing employees' learning and innovation. While most of the current literature focuses on leadership styles and managerial skills, limited research has considered the impact of leaders' technical competence on subordinates' learning and innovation. Data were collected from 52 leaders and 127 subordinates within 68 telecommunication companies in Vietnam. The results show that the leaders' technical competence has positive relationships with the subordinates' innovative and learning work behavior. Moreover, learning work behavior has a partial mediating effect on the relationship between the leaders' technical competence and the subordinates' innovative work behavior.

1. Introduction

The innovative potential of an organization resides in the knowledge, skills, and abilities of its people, both employees and leaders (Kelley et al., 2011). This is particularly true in high-tech industries where work has become more knowledge-based and less rigidly defined. In this context, employees can help to improve business performance through their ability to generate ideas and use these as building blocks for new and better products, services and work processes (De Jong and Den Hartog, 2007). However, in order for creative ideas to take place and be implemented, support for employees by their leaders is essential (Basadur, 2004; Ibarra, 1993). Scholars argue that leaders play a crucial role in enhancing employees' creativity (Kratzer et al., 2008) and innovation (Afsar et al., 2014), and in the development of innovation capability (Borjesson et al., 2014; Kelley et al., 2011).

Despite a vast amount of research linking leadership and innovation in organizations (Basadur, 2004; De Jong and Den Hartog, 2007; Shalley and Gilson, 2004), the employees' level is neglected. First, although individual employees propose innovative ideas, develop them, and advocate their implementation, most of the research into innovation and learning has been conducted at the organizational level of analysis. This ignores individual roles (Ibarra, 1993; Gumusluoglu and Ilsev, 2009). Second, the most available behavioral research on individual innovation has focused on the employees' creativity, while the implementation of ideas is explored far less often (De Jong and Den Hartog, 2007; Baer, 2012). Third, in most of the leadership research that investigates the impact of leaders on subordinates and their innovation, scholars have focused most exclusively on leadership behaviors or styles (e.g., transactional/transformational leadership, participative leadership,

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empowering leadership) (Shin and Zhou, 2003; Axtell et al., 2000; Badir et al., 2012; Zhang and Bartol, 2010; Afsar et al., 2014) and managerial skills (Carmeli and Tishler, 2006). With the exception of studies by Hysong (2008) and Slusher et al. (1972), which investigated the impact of leaders' technical skills on managerial performance and their managerial role adoption. Research attention has been limited on the technical competence of the leaders and the role it may play in influencing subordinates' learning and innovation.

In this research, we investigate the relationship between the leaders' technical competence and their subordinates' innovative work behavior (IWB) in knowledge-intensive firms because IWB plays a major role in shaping a firm's competitiveness and performance. Our first research question was: What is the relationship between the leaders' technical competence and their subordinates' IWB? This is a significant issue, especially in knowledge-based industries. First, work activities in these industries tend to involve non-standardized tasks and complicated, ill-defined problems for which novel and useful solutions are far from obvious (Zhang and Bartol, 2010, Slusher et al., 1972). Second, most often, leaders in these industries have engineering education and technical experience and skills. How these leaders impact their subordinates' innovative behavior becomes significant as well, to ensure the success and competitiveness of firms in these industries.

Despite widespread scholarly consensus that leaders influence IWB (Scott and Bruce, 1998), researchers have not delineated the mechanisms through which leaders affect IWB. Therefore, our second research question was: How does the leaders' technical competence impact the subordinates' IWB? In an attempt to understand the mechanism through which the leaders' technical competence impacts the subordinate's IWB, we drew on organizational learning theory to posit that subordinates' learning work behavior (LWB) reflects the relationship between their IWB and the leaders' technical competence. If the leaders' technical competence has a positive impact on the subordinates' LWB, then this will also have a positive impact on the subordinates' IWB.

2. Theoretical background and hypothesis development

This research seeks to understand the relationship between leaders' technical competence and the IWB of their subordinates, and the mediating role of LWB in knowledge-based industries. Our model is shown in Fig. 1.

2.1. Employee's innovative work behavior (IWB)

Organizational innovation includes both the development of new ideas (creativity) and the implementation of these ideas within an institutional context (van de Ven, 1986). Despite the widespread agreement that creativity and implementation are two distinguishable activities of an innovation process with potentially different antecedents (Axtell et al., 2000; Baer, 2012), researchers and practitioners alike often use them interchangeably (Scott and Bruce, 1994; Carmeli et al., 2006). Creativity can be viewed as the first stage of an innovation process (Baer, 2012). Creativity refers to the development of ideas that are both novel, something that has been done for the first time, and useful, either in the short or the long term (Amabile, 1996; Woodman et al., 1993). Idea implementation is more complex (Carmeli et al., 2006) and describes the process of converting these ideas into new (radical) and improved (incremental) products, services, or ways of doing things (Woodman et al., 1993; Baer, 2012; Aronson et al., 2006). However, innovation management research suggests that both, idea generation and implementation, are interrelated since the implementation of ideas requires finding or creating ideas in the first place (Parzefall et al., 2008). Therefore, innovation may be defined as a process that involves the generation, adoption, implementation and incorporation of new ideas, practices or artifacts within organizations (Axtell et al., 2000). As such, it is a broader and more complex concept than that of creativity. The concept of innovation involving both the generation and the implementation of ideas is not new (Mumford and Gustafson, 1988) and has been examined at different organizational levels.

The foundation of all innovations is ideas and it is employees who develop, carry, react to, modify and implement ideas (Janssen, 2000). The environment of organizations in knowledge-based industries, for example, telecommunications, is very dynamic (Shih and Susanto, 2011) and work activities tend to involve complicated non-standardized and non-routine tasks (Zhang and Bartol, 2010; Slusher et al., 1972). The routines implemented by organizations may not be able to respond quickly enough to rapid changes in technology, or to frequent technical problems that require fast and creative solutions. Employees

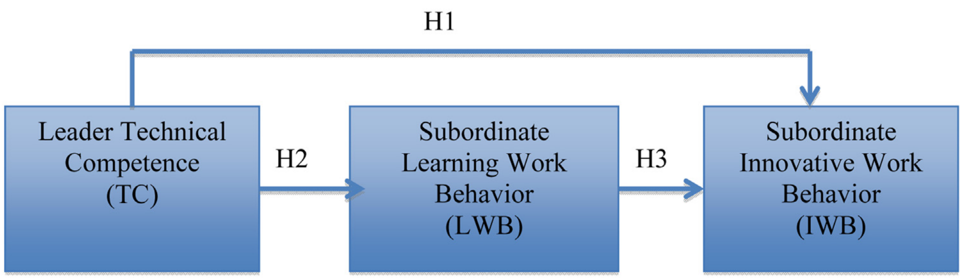

Fig. 1. Proposed Model.

in these industries therefore, need to develop, endorse, and implement new methods, approaches, or procedures (Shih and Susanto, 2011) to address the challenges in their work environment. They need to be able to perform tasks that go beyond the established routines for a team, group, or organization. They may search out new technologies, suggest new ways to achieve objectives, apply new work methods, and investigate and secure resources to implement new ideas (Yuan and Woodman, 2010). These activities are referred to as innovative work behavior (IWB), defined as an employee's intentional introduction or application of new ideas, products, processes, and procedures in his/her work role, work unit, or organization, in order to benefit role performance, the group, or the organization (Yuan and Woodman, 2010; Jong and Hartog, 2010; Janssen, 2000). Carmeli and his colleagues (2006) specify that an employee's innovative behavior is the foundation of any high-performance organization.

Innovative work behavior is related to organizational citizenship behavior, which reflects an individual's willingness to invest exceptional effort, above and beyond the prescribed roles, and to voluntarily help fellow coworkers achieve group objectives, for example, employees who voluntarily take time away from their own tasks to assist peers with work-related problems (Aronson and Lechler, 2009). However, IWB focuses specifically on individuals' innovation related to their work tasks. Walumbwa et al. (2009) consider that organizational citizenship behavior is usually seen as separate from "in-role" or technical aspects of job performance. Both are important dimensions of the employees' effectiveness but they are usually viewed as conceptually distinct.

In this research, the employees' IWB was conceived as a complex process combining both creativity and implementation of ideas (Janssen, 2000, 2004). It consists of four dimensions (Jong and Hartog, 2010): idea exploration; idea generation; idea championing; and idea implementation. *Idea exploration* includes looking for ways to improve current products, services or processes or trying to think about them in alternative ways. *Idea generation* may relate to new products, services or processes, the entry into new markets, improvements in current work processes, or in general terms, solutions to identified problems. *Idea championing* is defined as individuals who emerge to take creative ideas (which they may or may not have generated) and bring them to life (Howell and Higgins, 1990). Most ideas need to be promoted because they do not match what is already used in their work group or organization. This includes mobilizing resources, persuading and influencing, pushing and negotiating, and challenging and risk-taking (Kleysen and Street, 2001). Finally, ideas need to be *implemented*. Considerable effort and a result-oriented attitude are needed to make ideas into products, processes or services. Idea implementation also includes making an innovative part of regular work processes and behaviors like developing new products or work processes, and testing and modifying them (Kleysen and Street, 2001; Kanter, 1988; Jong and Hartog, 2010).

Although prior research treated IWB as multi-dimensional, with different activities and different individual behaviors necessary in each dimension, available measures of IWB are typically one-dimensional (Reuvers et al., 2008; De Jong and Den Hartog, 2010; Janssen, 2000; Scott and Bruce, 1994). It is treated as such in this research. Since IWB is actually characterized by discontinuous activities rather than discrete, sequential activities, Scott and Bruce (1994) and Janssen (2000) emphasized that innovative employees can be expected to be involved in any one, or combination, of these dimensions at any one time.

2.2. Leader's technical competence (TC)

The field of leadership in organizations mostly involves two distinct perspectives. The first is one-way direction that focuses mainly on the leader and aims at understanding the impact of leader behaviors and characteristics on the performance of an individual, a team, and an organization (Wang et al., 2005; Bass, 1985). The second is two-way direction that focuses on the relationship quality between a leader and a follower (subordinate), described by leader-member exchange (LMX) theory (Liden and Graen, 1980; Graen and Uhl-Bien, 1995). In this article, we adopt the first perspective, one-way direction, and examine the vertical relationship between the leaders and their subordinates, specifically, the influence of the leaders' technical competence on subordinate innovation and learning.

Leadership research indicates that leaders play critical roles in shaping employees' attitudes and behavior (Tymon et al., 2011; Aronson et al., 2013). They are representative of the organization and provide job resources that facilitate employee learning and innovation. The creators of the context in which subordinates operate, learn and innovate (Hannah and Lester, 2009). Leaders are knowledgeable about an individual's work, and have considerable influence over the context within which employee creativity and innovation occur (Shalley and Gilson, 2004). The leadership literature has acknowledged the impact of leaders' styles and behaviors (Axtell et al. 2000, Scott and Bruce, 1994) and leadership competence, (Bartram and Casimir, 2007) on their subordinates' innovation activities. However, there has been limited research on the impact of a leaders' technical competence on subordinate innovation and learning behavior.

There is no consensus regarding how to define an individual's competence. For instance, Boyatzis (2008) defined it as a capability. Schoorman et al. (2007) referred to it as the individual's ability, or how reliably and competently an employee can perform his/her job. Spencer and Specer (1993) stated that a competency is an individual characteristic that can predict behaviors and performances that are effective or superior in the work situation. Others defined competency as the underlying characteristics related to the effectiveness and individual performance on the job (Levenson et al., 2006). In this article, we define leaders' competency as the ability and capability of the leaders to perform their duties, and how good they are in terms of technical skills, knowledge, and experience. Accordingly, a leader is technically competent when he/she has: (i) up-to-date technical knowledge and ability to perform technical duties; (ii) understanding of the technologies involved, (Grant et al., 1997); and (iii) ability to answer technical questions, suggest technical solutions, and apply knowledge to problems (Rosen et al., 1976; Hysong, 2008). This definition is adopted because the research's focus is on the technical aspect of leaders' competence in technology-intensive industries, specifically telecommunications. Other competences, such as managerial competence, are not considered in this research.

2.3. Leader's technical competence and employee IWB

The limited available literature related to the impact of leaders' technical competence on subordinates reveals mixed opinions (Hysong, 2008). Some researchers suggested a positive relationship between technical competence and innovation of subordinates. For instance, Dooley and Fryxell (1999) indicated that one of the person-specific conditions identified as the affecting perceptions of trustworthiness is the belief that leaders are competent in their professed area of expertise. The trust between leaders and subordinates improves subordinate performance, including innovation performance. This finding has been repeatedly described and supported in the literature. In examining long-term project teams, Allen et al. (1988) found that team performance was higher when functional managers were technically competent and performed roles related to technology, including disseminating information regarding technical advances and being knowledgeable regarding current professional activities.

Grant et al. (1997) has shown that technical skills are perceived to be very significant managerial characteristics, especially in high-performance teams and during the early stages of a project. Others found in the innovation context, high performance is directly related to the perceived task (technical) competence of the leader (Hollander and Julian, 1970). Andrews and Farris (1967) argued that more team innovation occurred under leaders who knew the technical details of their teams' work, who could critically evaluate that work, and who could influence work goals. Similarly, Grant et al. (1997) indicated that an understanding of the specific technology is essential for project managers to participate effectively in the search for technological innovations and integrated solutions. De Jong and Den Hartog (2007) argued for the role of the leader as a driving force behind employee innovative work behavior. Highly competent leaders will demand up-to-date technical solutions to problems they face. The subordinates will be challenged to come up with creative solutions to meet the leaders' expectations. This challenge will encourage subordinates to put in more effort, increasing more subordinates' IWB. Leaders with technical knowledge and problem-solving ability in ever-increasing complex systems are crucial to the future of the organization (Morris and Williams, 2012) and its innovation performance.

However, some researchers found a negative relationship between leaders' technical competence and their subordinates' performance. Slusher et al. (1972) found that if managers had technical competence, employees rejected the managerial role, which in turn resulted in a nonproductive work group. However, he studied only one organization, with a focus on a designated group, and admitted that his results may not be generalizable. Badawy (1995) found that the need for technical skills decreases as managers rises to higher levels of management. However, he also proposed that technical skills are critical for managers who serve several important functions, such as communicating effectively with subordinates, verifying the soundness of the decisions they make, and making program-level decisions based on subordinates' suggestions, which are important for subordinate innovation.

Earlier, Katz (1955) stated that, in a general management environment, technical skill is indispensable. But, as leaders advance in the organization, away from the actual physical operation, the importance of technical skill declines as the leaders rely more extensively on human and conceptual skills. Twenty years later, Katz (1974) refined his premise to suggest that it is an exceptional case in which technical skill becomes unimportant, regardless of the level of management. In supporting this positive view, researchers have argued that the lack of technical competence may negatively impact information sharing, thereby undermining effectiveness (Boss, 1978). Effective information sharing is essential in order for innovation to take place.

We postulate that because technically competent leaders keep current in their field and have technical experience and capability, the subordinates may consider them the main source of knowledge, and consult them whenever issues or problems arise at work, or simply to improve the work processes and activities. Murphy and Kumar (1997) suggest that regular contact between management and technical personnel serves as a valuable means of generating ideas. Chandy and Tellis (1998) assert that new product ideas are much more likely to be developed if project leaders possess technical expertise and sufficient knowledge and experience in technology, markets, required resources, company fit and capabilities, and company limits. Ambiguity in an individual's mind about technical feasibility and consumer acceptance is diminished by technical leaders. We posit that leaders will be able to have a positive discussion with their subordinates in this scenario and provide intellectual stimulation. Technically competent leaders help their subordinates to recognize and solve important technical problems (Grant et al., 1997). Through deep discussion and deliberation, the subordinates will be able to clearly identify the problems and understand them. This will facilitate finding creative solutions. Moreover, since the technically competent leaders understand the problems and their importance, it is likely that they will provide the subordinates with the desired resources including equipment, facilities, and time to implement the generated ideas and solutions (Wilson et al., 2010). Therefore, it is proposed that:

H1: There is a positive relationship between leaders' technical competence and subordinates' innovative work behavior.

2.4. Leader's technical competence and employee LWB

Learning has been described in the literature as a change in behavior resulting from experience. This experience could be based either on actions and events, detecting and correcting error (Argyris and Schön, 1978)) or information and knowledge

(Sarin and McDermott, 2003). Individual learning behavior is the approach an individual takes to learning situations (Van Gelderen et al., 2005). The way in which some individual deals with a specific situation affects the kind and extent of learning from this particular situation. Learning behavior is a process of change in cognition and behavior that requires basic shifts in how people perceive, think, and interact (Dechawatanapaisal, 2006). This depends to some extent on the learning context (Van der Sluis, 2002). At the a team level, learning behavior is defined by Edmondson (Edmondson, 1999) as an ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions. However, even within the team, it is the individual who makes the effort to learn. Scholars argue that team learning behavior involves the process through which individuals acquire, share, and combine information, in addition to testing assumptions, reflecting on or discussing errors, and experimenting (Edmondson, 1999). Consistent with this conceptualization, we define subordinate learning behavior as the process of knowledge and information acquisition and sharing. It involves setting learning and development goals, commitment to learning, and seeking knowledge and learning opportunities mainly through discussion and interaction with leaders and colleagues.

Most of the research in this domain has focused on learning at the organizational level and centers primarily on the consequences of learning on performance, such as creativity, innovation and efficiency (Bontis et al., 2002). The antecedents of learning have received less attention, especially at the individual level (Dechawatanapaisal, 2006; Van der Sluis, 2002). The individual level is significant because it is the very foundation on which organizational learning takes place. For example, Hedberg (1981) claimed that organizations themselves do not learn but their members act as agents to study on behalf of their organizations, and this is how the organizational learning process takes place. Indeed, the involvement of individuals in learning behavior leads to the creation of organizational learning (Dunphy et al., 1997).

To study the antecedents of learning, scholars have examined the leadership influence on organizational learning. The leadership literature suggests that top-down learning processes can be initiated and controlled by senior leaders (Van de Ven and Poole, 1995). More recently, however, leadership scholars have opposed this view by arguing that social systems in complex organizational contexts are inherently unstable and unpredictable, and the causal effects of leadership on organizational outcomes, such as learning, are rarely directly observable or entirely deterministic (Hannah and Lester, 2009; Hannah et al., 2008). Leaders enhance organizational learning by setting the conditions and structure for learning to occur, and may increase the level of developmental readiness of individual followers, thereby increasing their motivation and ability to approach learning experiences (Hannah and Lester, 2009). Scholars have also investigated the impact of leaders on learning in the team context. For example, Edmondson (2003) studied the impact of team leaders on learning in interdisciplinary teams and suggested that they play a critical role in helping their team members frame and reframe knowledge and the learning experience. Sarin and McDermott (2003) argued that leadership characteristics in new product development teams affect learning, knowledge application, and the subsequent performance of these teams. Aronson et al. (2006) suggested that to achieve project success, project leaders create a collaborative culture that fosters learning from mistakes, encourages risk-taking and experimentation. This review suggests that there is a consensus among researchers that leaders affect learning at all levels in the organization. In this research, we investigate the influence of the leaders' technical competence on subordinates' LWB, which is a gap in the leadership literature.

Coad and Berry (1998) asserted that the value of learning goals for an individual may be increased if the leaders stress the importance of becoming more skilled and knowledgeable, provide positive feedback when competence is improved, emphasize that most learning occurs during the execution of new and more difficult tasks, and indicate that mistakes are all part of the learning process. Ellinger and Bostrom (1999) found that in learning organizations, leaders are consciously attempting to foster their employees' learning and overall development. They found that leaders facilitate subordinates' learning through providing feedback, and solving work problems together. Leaders use analogies, scenarios, and examples, and engage others to facilitate learning. This broadens the employees' perspectives by getting them to see things differently.

We argue that when the leaders are technically competent, knowledgeable, and expert in their area of work, they will facilitate and support subordinates' learning through discussions related to work activities based on their expertise and motivating the subordinates to set goals for their own self-learning. We suggest three possible situations that can facilitate and encourage the subordinates to seek knowledge and learn. (1) When the leaders talk to their subordinates, they will most likely ask deeper and more meaningful questions, and try to see the issues under discussion from different angles. This will help the subordinates to see the problem from different perspectives and most likely motivate the subordinates to find answers to the questions raised by the leaders. (2) The technically competent leaders may take some actions or provide solutions to technical problems based on their expertise. The subordinates might become curious to understand why this solution was taken to solve this problem. This curiosity may lead the subordinate to learn more. (3) When a technically competent leader talks to his/her subordinate about work, there will be knowledge transferred from the leader to the subordinate, which is learning. However, due to leaders' time constraints, they may not explain everything in enough details and will only give suggestions about how to solve work problems. This will motivate the subordinates to find up-to-date knowledge to examine the suggestions given by the leaders, reflect on them and select the one that best suits the situation. We posit that the subordinates will most likely look for different kinds of knowledge, from different sources, externally and internally, and come back to the leaders with several solutions and ideas, to discuss them and select the best, which will lead to a high degree of learning work behavior. In addition, as proposed in hypothesis 1, the competent leaders will stimulate subordinate IWB. Therefore, if the subordinates engage in IWB then they will upgrade their knowledge, and increase their learning activities. Therefore, it is proposed that:

H2: There is a positive relationship between leaders' technical competence and subordinates' learning work behavior.

2.5. The mediating role of LWB

A vast amount of research on learning and innovation supports that learning leads to innovation at the individual (Wang and Ahmed, 2003; Dahlander et al., 2016), team (Barker and Neailey, 1999), and organization level (Park et al., 2014; Svetina and Prodan, 2008; Cohen and Levinthal, 1990). Scholars in Psychology specify that learning is most meaningful, rapid, and satisfactory when the learners see that what is being learned is significant to them, and helps them to accomplish a goal which seems to them important (Hattie and Yates, 2013), such as solving work problems. In line with the literature, we postulate that a subordinate's LWB has a positive relationship with the subordinate's IWB. With reference to H2, we further argue that the subordinates' LWB mediates the relationship between a leaders' technical competence and the subordinates' IWB.

Technically competent leaders are in a strong position to support the subordinates search for knowledge since they know what kind of knowledge is needed inside their organization. They also are likely to be aware of the gap in their subordinates' knowledge, and know where to find needed knowledge (Tushman, 1977; Kanter, 1983; Hannah and Lester, 2009; Elkins and Keller, 2003; Dokko and Gaba, 2012). This supports the subordinates' search for knowledge to be more focused and the knowledge gained very specific to the organization's needs, resulting in more effective learning behavior. Moreover, after searching and collecting knowledge, the subordinates will most likely discuss this new knowledge with the technically competent leaders and colleagues to find out whether a solution fits the problem or is compatible with the organization's knowledge stock. This helps the subordinates to customize and tailor the knowledge gained to the organization's specific environment and its tasks (Dokko and Gaba, 2012).

We also posit that the characteristics of subordinates and leaders involved directly or indirectly in the learning processes are likely to facilitate and support the transformation of knowledge into innovation. For instance, the leaders who help subordinates to evaluate technical concepts and solutions, to assess risks and make trade-off decisions, and instruct subordinates in how to integrate this knowledge into the organization's existing knowledge base, will most likely support the transformation of subordinate knowledge into innovation. This support may include using their power and influence to persuade others of the desirability of the change proposed by the subordinate which will minimize the resistance of the others to the proposed solutions (Ibarra, 1993).

The leaders may mobilize material resources that the subordinates need to implement for their solutions. As for the subordinates, we postulate that their self-confidence will increase, which facilitates the transformation of knowledge into innovation. Indeed, through targeted learning, the motivation to seek specific knowledge, and the exchange of ideas with technically competent leaders, the subordinates will enhance their technical competence (Kocoglu and Ince, 2011). This will increase their confidence in the implementation of innovation. With reference to H2, we propose that:

H3: Subordinates' learning work behavior mediates the relationship between technical competence and innovative work behavior.

3. Research methodology

3.1. Sample and data collection

In this study, the telecommunications industry was selected because it is one of the fields in which technological change is fastest and which experiences high competition among the players (Phelps, 2010). Therefore, employee learning and innovation play major roles in the survival and success of the firm. In addition, most leaders of telecommunication companies have technical education and expertise.

We selected one industry because our dependent and mediating variables are IWB and LWB respectively, and these variables may differ from one industry to another. We understand that by selecting one industry we may limit the generalizability of the study. This will be explained later in the discussion section. However, we wanted to ensure the sufficient homogeneity of the sample (Eisenhardt and Schoonhoven, 1996). The organization selected for the study was Vietnam Post and Telecommunications (VNPT) Group. VNPT is an incumbent telecommunications operator in Vietnam with over 45,000 employees and a modern telecommunications infrastructure throughout the country, providing a full range of telecommunication services such as telephone landlines and mobile telephone services, broadband Internet, and data communication. The 68 subsidiaries of VNPT include 63 provincial telecom companies that provide landlines and broadband Internet as well as two mobile phone companies, one data communication company, one international telecommunication company, and one national telecommunication company. Each of these companies has between 500 and 2000 employees.

The questionnaire was first written in English and initially cross-checked by three business and management professors from Thailand and Vietnam. Then, for instrument validity we conducted a pilot test in which we interviewed five managers from three different telecommunication companies and ten MBA students whose first degree was in telecommunication, all in Bangkok, Thailand. We requested their feedback regarding concept clarity, question validity, and the appropriateness of the questionnaire items. We revised the questionnaire based on the feedback of both scholars and professionals. The questionnaire was then translated into Vietnamese. In accordance with the common wisdom of wording and translation (Brislin, 1986), we translated the Vietnamese version back into English. After comparing the two English versions, some editing was made to the Vietnamese version.

To increase the response rate and to ensure the confidentiality, one of the authors personally administered structured questionnaires and collected them on site. Two structured questionnaires were administered: one survey to the subordinates, and the other to their direct managers. Based on the organizational structure of the VNPT Group and with help from its management, we identified the leaders and their subordinates (three subordinates for each leader). The leaders were 68 General Managers (GMs) of subsidiaries of the VNPT Group. Leadership scholars (Badawy, 1995; Katz, 1974) suggested that technical skills are critical for top managers in high-tech organizations in which these skills help them to communicate effectively with the technical staff, and to make sound decisions regarding technical issues. The three subordinates were the directors of the telecom division, business division, and telecom center in each subsidiary. The questionnaires were sent to all the 68 subsidiaries of VNPT. Each company's manager received a questionnaire asking about the innovative work behavior of three subordinates and also included a request to self-assess his/her technical competence. The three subordinates also received questionnaires and were asked to self-assess their learning work behavior and rate the manager's technical competence.

A total of 52/68 managers replied (a response rate of 76.5%) and 127/204 subordinates replied (a response rate of 62.2%) representing a total of 127 dyads. The data sample included: 30 managers who had three subordinates' respond; 15 managers who had two subordinates' respond; and seven managers who had only one subordinate answer the questionnaire. Data were entered and processed for analysis using SPSS and AMOS software.

3.2. Measurement

3.2.1. IWB

De Jong and Hartog (De Jong and Den Hartog, 2010) developed a measure for IWB with ten items that included four dimensions (idea exploration; idea generation; idea championing; and idea implementation). The ten original questions were used. The leaders were asked to rate their subordinates' innovative behavior. Examples of items included in the scale are: *"Does this subordinate generate original solutions to problems?", "Does this subordinate attempt to convince people to support an innovative idea?"*.

3.2.2. LWB

Out of 35 items measuring learning work behavior in the workplace, which were developed by Dechawatanapaisal and Siengthai (2006), only 8 items were used in this research related to subordinates' learning work behavior. The remaining 27 items were related to organization and management level. Subordinates were asked to rate their own learning behavior. Sample items include: *"I am trained and coached to learn how to develop myself", "I talk to staff and manager about successful programs or work activities in order to understand why they succeeded"*.

3.2.3. TC

In order to assess leader's technical competence in telecommunications fields, we refer to Chien (2007) who specified the knowledge and skills needed by telecommunication professionals. In collaboration between one of the authors and 10 interviewees from VNPT, three core competencies were identified: new technologies, network and system, and new services. The (VNPT) Group management agreed that these questions were suitable. Three questions were directed to the managers asking them to rate their technical competence (TLC). A sample item includes: *"My manager is aware/knowledgeable of most potential technical problems that team members may face"*. Four questions (e.g. Could you rate your understanding about new services in telecommunications?) were directed to the subordinates (TCS) asking them to rate their manager's technical competence.

Slusher et al. (1972) established a method to measure and calculate the technical competence of a team leader. We applied the same method in this research. First, each leader rated his/her own technical competence. Second, subordinates rated the technical competence of their leaders. The leader's technical competence was calculated as the average score of leader's self-assessment and of subordinate's (one, two or three subordinates) average assessment of the leader.

4. Results

4.1. Assessing reliability and validity measures

4.1.1. TC

The leader's technical competence is measured by two components: In the first component, the subordinates rated the leader's technical competence through four questions. In the second component, the leaders self-rated their technical competence by answering three questions. The Cronbach's alpha was 0.894 confirming the reliability of the scale. Nunnally (1978) recommends that instruments used in basic research with reliability of about 0.70 or above is reliable.

Exploratory Factor Analysis (EFA) was applied using SPSS software to explore the dimensions of the TC items. The EFA result had two components, with initial eigenvalues at 3.572 and 1.743 > 1, which explained 75.934% of the variance, so they were selected. For eigenvalues over option the default is Kaiser's recommendation of eigenvalues over 1 (Field, 2005). The first component had four items that describe how subordinates rated the leader's technical competence, it is called TCS. The

Table 1
The results of factor analysis and reliability test.

Research construct		Research item	Eigenvalue	Variable explained (%)	Factor loading	Cronbach's α	Kaiser-Meyer-Olkin (KMO)	Item to total
Leader Technical Competence						0.894	0.778	
	TCS: subordinates rate leader's technical competence		3.572	51.028				
	[7-point Likert-type: strongly disagree/strongly agree]							
	When the team members face a technical problem, the manager sometimes provides a technical solution				0.873			0.734
	My manager is aware/knowledgeable of most possible technical problems that team members may face				0.891			0.812
	My manager is always learning about and updating new technology trends and their applications				0.837			0.788
	My manager is technically experienced and fully competent; can exercise independent judgment regarding all technical issues				0.836			0.744
	TCL: leader self-assessment of technical competence		1.743	24.906				
	[7-point Likert-type: very low/very high]							
	Could you rate your understanding about telecommunication networks?				0.846			0.695
	Could you rate your understanding about new technologies in telecommunications?				0.850			0.675
	Could you rate your understanding about new services in telecommunications?				0.846			0.662
Subordinate Learning Work Behavior	*Subordinate self-assessment* *[7-point Likert-type: strongly disagree/strongly agree]*					0.832	0.793	
	LBS: subordinate self-learning		3.946	49.327				
	I set goals for my own learning				0.859			0.786
	I set targets for my development				0.540			0.534
	I am trained and coached to learn how to develop myself				0.830			0.539
	Personally, I am committed to continuous learning				0.611			0.634
	I view new problems and work challenges as opportunities to develop my skills				0.830			0.625
	LBO: subordinate learning through discussion		1.298	16.220				
	To do my job, I usually discuss and learn from my manager and colleagues and I share what I learn				0.831			0.598
	I talk to staff and manager about successful programs or work activities in order to understand why they succeeded				0.530			0.541
	At work, I consider the pros and cons of many alternative solutions and I discuss them with my manager and colleagues before I select an appropriate course of action				0.743			0.751
Subordinate Innovative Work Behavior	*Managers rate their subordinates' innovative behavior* *[7-point Likert-type: strongly disagree/strongly agree]*					0.949	0.89	
	IBG: idea generation, idea exploration		7.071	70.707				
	Does this subordinate search out new working methods, techniques or instruments?				0.789			0.703
	Does this subordinate generate original solutions to problems?				0.620			0.856
	Does this subordinate find new approaches to execute tasks?				0.567			0.878
	Does this subordinate pay attention to issues that are not part of his/her daily work?				0.845			0.502
	Does this subordinate wonder how things can be improved?				0.537			0.879
	IBI: idea championing, idea implementation		1.016	10.162				
	Does this subordinate encourage key organizational members to be enthusiastic about innovative ideas?				0.879			0.710
	Does this subordinate attempt to convince people to support an innovative idea?				0.893			0.733

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Table 1 (*Continued*)

Research construct		Research item	Eigenvalue	Variable explained (%)	Factor loading	Cronbach's α	Kaiser-Meyer-Olkin (KMO)	Item to total
	Does this subordinate systematically introduce innovative ideas into work practices?				0.778			0.870
	Does this subordinate contribute to the implementation of new ideas?				0.796			0.884
	Does this subordinate put effort into the development of new things?				0.793			0.905

second component had three items that relate to leader's self-assessment of technical competence, it is called TCL. All factor loading values were ≥0.5 and no items were deleted.

4.1.2. LWB

Learning work behavior was measured from answers to eight questions. Reliability was acceptable with Cronbach's α at 0.832.

The EFA result has two components, with initial eigenvalues at 3.946 and 1.298 > 1, which explained 65.547% of the variance, so they were selected. The first component has four items that relate to how subordinates self-learn, it is called LBS. The second component has four items that relate to how subordinates learn through discussions with colleagues and leaders, it is called LBO. All factor loading values were ≥0.5 and no items were deleted.

4.1.3. IWB

Innovative work behavior was measured from answers to ten questions. Cronbach's α was 0.949, which confirmed the scale's reliability. Intercorrelations between the two dimensions of innovative behavior (idea generation and idea implementation) were over 0.82. Given these high intercorrelations, these dimensions were combined additively to create an overall scale of innovative behavior.

Table 1 reports the results of factor analysis and the reliability test. To validate the developed constructs (TC, LWB, and IWB), the research model was estimated with a confirmatory factor analysis. The test result of adaptability were $\chi^2 = 387.89$, df = 164, χ^2/df = 2.37, RMSEA (root mean square error of approximation) = 0.057, GFI = 0.92, NFI (normed fit index) = 0.96, NNFI (non-normed fit index) = 0.95, and CFI (comparative fit index) = 0.95, indicating that the model achieved acceptable adaptability standard as suggested by Hair et al. (2006) and Byrne (1998) (χ^2/df < 3, RMSEA = 0.08, NFI = 0.90, NNFI = 0.90, CFI = 0.90).

Table 2 presents means, standard deviations, and correlations of the study variables. As expected, TC is significantly correlated with innovative work behavior (r = 0.56, $p < 0.01$) as well as with LWB (r = 0.37; $p < 0.01$). Moreover, LWB was also positively related with IWB (r = 0.52; $p < 0.001$).

4.2. Assessing the model fit with structural equation modeling (SEM)

Simultaneous maximum-likelihood-estimation procedures were utilized in order to examine the hypothesized relationships among TC, LWB, and IWB. We represented each latent construct with a single index that is equal to the average score on the construct scale. Structural equation model combines aspects of multiple regression and factor analysis to estimate a series of interrelated relationships among variables simultaneously. Table 3 shows the results for fit indices of direct, full mediation and partial mediation models. The difference ($\Delta\chi^2$) between the Direct Effects Model and Full Mediation Model χ^2 was 34.5. The LWB full mediating role is confirmed if the relationship between TC and innovative work behavior disappears when LWB is introduced into the regression equation predicting innovative work behaviour. Similarly, the partial mediation is confirmed when the coefficient between effective TC and innovative work behavior after introducing LWB into the regression equation remains significant but is reduced. The indices, GFI, CFI, NNFI, and RMSEA of the Full Mediation Model showed good adaptability indicating that the Full Mediation Model had better adaptability than the Direct Effects Model. For the GFI, CFI, and NNFI indices, values greater than 0.90 are typically considered acceptable, and values

Table 2
Descriptive analyses.

	Scale		Inter-correlations		
Variable	Mean	S.D	1	2	3
1. TC	5.32	1.01	1		
2. LWB	5.13	0.67	0.37*	1	
3. IWB	5.98	0.83	0.56*	0.52**	1

* $p < 0.01$; ** $p < 0.001$.

Table 3
Results for fit indices of structural models.

Model	χ^2	χ^2/df (<2)	$\Delta\chi^2$	GFI(>0.9)	CFI(>0.9)	NNFI(>0.9)	RMSEA(<0.08)
Direct Effects Model	456.3** (df = 166)	2.75	–	0.774	0.793	0.847	0.073
Full Mediation Model	421.8** (df = 168)	2.51	34.5	0.85	0.87	0.89	0.062
Partial Mediation Model	388.7** (df = 164)	2.37	33.1	0.92	0.95	0.96	0.051

Note: $\Delta\chi^2$ presents differences between model and the following model.
** $p < 0.001$.

greater than 0.95 indicate good fit to the data (Byrne, 2001; Hu and Bentler, 1999; Steiger, 1998). For well-specified models, an RMSEA of 0.06 or less reflects a good fit (Hu and Bentler, 1999).

Next, we compared the Partial Mediation Model to the Full Mediation Model; the difference ($\Delta\chi^2$) of χ^2 was 33.1. Adaptability indices were χ^2/df = 2.37, GFI = 0.92, CFI = 0.95, NNFI = 0.96, and RMSEA = 0.051, which demonstrated that partial mediation was more adaptable than full mediation. The model adaptability was satisfactory, and in accordance with the research framework. The results show that the Partial Mediation Model was a suitable model.

Table 4 presents the results of the coefficients, t-values and goodness-of-fit statistics. The χ^2 statistic was significant; other fit indices, including GFI (0.95), CFI (0.96) NNFI (0.96), RMSEA (0.051, 90% CI = 0.049–0.068) indicated that the proposed model is a reasonable explanation of observed covariance among the study constructs. In addition, the model achieved a satisfactory level of goodness of fit in predicting the variance of TC (51%) and innovative work behavior (44%). As expected, TC and LWB were two powerful predictors of innovative work behavior (the coefficients were 0.63 and 0.45, respectively). Similarly, TC and LWB positively predicted the IWB of employees (the coefficients were 0.55 and 0.33, respectively).

These results provided additional support that the effect of TC on innovative work behavior was significant ($\beta = 0.68$, $p < 0.001$), supporting Hypothesis 1. The effect of TC on LWB was also positive and significant ($\beta = 0.47$, $p < 0.01$), supporting Hypothesis 2. We used a three-step approach to test the mediating effect of LWB on the relationships between TC and IWB. This approach first regresses LWB on TC. If this regression is significant, then IWB is regressed on the TC in a second regression model. Finally, if the second regression is found to be statistically significant, IWB is regressed on LWB and TC using the same regression. The reduction in the effect size of TC in this final regression supports mediation. An insignificant TC in this final regression indicates full mediation. According to Table 5, TC featured significant path coefficient (TC → IWB: 0.55, $p < 0.01$) on innovative work behavior. Based on the complete mediation model in Table 5, the coefficients between TC

Table 4
Structural Equation Models of TC, LWB, and IWB.

	Coefficient	t-value
Dependent variable: LWB		
R^2	0.54	
TC	0.52	8.29*
Dependent variable: Innovative work behaviour		
R^2	0.79	
TC	0.67	6.21*
LWB	0.49	7.36*
Goodness-of-Fit Statistics		
Chi-square (p-value)	326.55	
df	165	
GFI	0.953	
CFI	0.961	
NNFI	0.964	
RMSEA	0.051	
(90% CI)	(0.049–0.068)	

* $p < 0.05$.

Table 5
Results of multilevel path analysis.

	Standardized path coefficients(t-value)		
	Direct Effects Model	Full Mediation Model	Partial Mediation Model
TC → IWB	0.55 (3.69**)		0.48(3.49**)
TC → LWB		0.66 (3.81**)	0.55 (4.22*)
LWB → IWB		0.62(3.1***)	0.57(3.14**)

* $p < 0.05$, ** $p < 0.01$, *** p- < 0.001.

Table 6
The mediating effect of LWB.

	Sobel test statistic	TC → LWB	TC → IWB	LWB → IWB	TC → IWB; mediator controlled
Innovative work behavior	3.85***	0.41	0.6	0.45	0.57

*** $p < 0.001$.

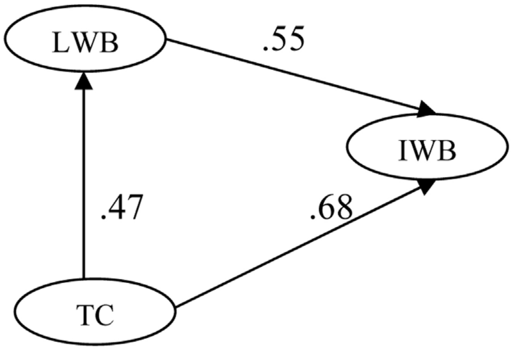

Fig. 2. Structural Model.

All paths are significant at 0.01 level.

and LWB were positive and significant (TC → LWB: 0.66, $p < 0.01$), as was the effect of LWB on innovative work behavior (LWB → IWB: 0.62, $p < 0.001$). The study found that LWB was a partial mediator between TC and innovative work behavior. In addition, TC positively influenced innovative work behavior ($\beta = 0.68$, $p < 0.01$).

The increased R^2 value (0.25, from 0.54 to 0.79 for IWB) resulting from adding LWB in the equation as shown in Table 5 is significantly large thus supporting mediating role of LWB. The reduced effect size of TC ($\beta = 0.57$; $p < 0.001$) coupled with the significance of LWB ($\beta = 0.45$; $p < 0.001$) implies that LWB partially mediates the relationship between TC and innovative work behavior. LWB explained an additional 19% of the variance in innovative work behavior when compared to the effect of TC alone. The study supports Hypothesis 3 that LWB was the partial mediation variable between TC and innovative work behavior. The Sobel (1988) test was also performed to test the significance of the mediation. Table 6 confirms that LWB partially mediated the relationship. The goodness of fit of the structural model is shown in Fig. 2.

5. Discussion

This research has developed and tested a conceptual model that investigated the relationship between leaders' technical competence and employees' innovative work behavior, a topic that has been missing from the leadership literature. Furthermore, the model shows how the employee's learning behavior mediates this relationship. The findings indicated that in high-tech industries, such as the telecommunications industry, leaders' technical competence is defined as up-to-date technical knowledge and the ability to perform technical duties better than their subordinates. They have a better understanding of the technology involved, and the engineering tools and techniques employed. Leaders have the ability to answer technical questions, suggest new methods, and apply knowledge to a problem and solve science and engineering problems). LTC has a positive relationship with subordinate's learning and innovative work behavior. Moreover, the learning behavior of the employees has a positive relationship with IWB. These results have interesting theoretical and practical implications.

The theoretical implications of this research are three-fold. First, this research fills a gap in the leadership literature by focusing on a different quality of leadership, one that has received little attention from leadership researchers. Most of the research that has investigated the relationship between leadership and subordinate innovation and learning behavior has focused on leadership behaviors and styles, or management skills (Rank et al., 2008; Shin and Zhou, 2003; Axtell et al., 2000; Badir et al., 2012; Zhang and Bartol, 2010; Kratzer et al., 2008). This research focuses on the relationship of technical competence with the subordinates' IWB and LWB. This research also expands upon the limited research that exists on leader technical competence, such as the work of Hysong (2008) and Grant et al. (1997) who investigated the impact of the leader's technical skills on managerial performance and the adoption of managerial roles. The results of this research are in line with the findings of Andrews and Farris (1967), who examined the impact of technical supervisors on the innovation of scientific teams (team level). However, their work was descriptive rather than inferential, and focused on the team rather than on the individual, compared to this research. We take their work a step further by studying the relationship of the leader's technical competence with the behavior of subordinates in learning and innovation.

Second, this research contributes to the organizational learning literature by focusing on learning at the an individual level, rather than on the firm (Hernandez-Espallardo et al., 2012) or team (Edmondson and Nembhard, 2009) level. The organizational learning literature has concentrated on identification the characteristics of organizational learning by investigating the relationship between organizational learning and performance (Borgatti and Cross, 2003), rather than examining how to influence the learning process (Dechawatanapaisal, 2006), especially at the an individual level. The results of this research support and expand upon other work on learning, either at the team or individual levels, by suggesting a mechanism through which leaders can impact individual learning. Edmondson's (2003) research investigated the impact of team leaders on team learning. In her research, Edmonson highlighted the importance of team leader behavior and actions, such as coaching (team leader coaching is the direct interaction with the team intended to shape individual and team activities to promote desired outcomes), to promote learning among team members. The results of this research suggest that in high-tech organizations, leaders who have technical competence to coach and monitor their subordinates, who are then inspired to learn more.

Finally, this research is consistent with evidence suggesting that leaders may increase the level of developmental readiness of individual followers, thereby increasing their motivation and ability to approach learning experiences (Hannah and Lester, 2009). Leaders with high technical competence, through their direct discussion with their subordinates and due to their deep technical knowledge, may indeed increase the subordinates' developmental readiness, and increase learning ability.

Our model is valuable for management practice regarding the relationship between technical leaders and subordinates innovation and learning. Since technically competent leaders have up-to-date technical knowledge, able to perform technical duties, and are able to answer technical questions, the subordinate will likely turn to them whenever he/she needs help to solve work-related problems. The feeling that the leader is there to help and guide them, results in a sense of obligation and indebtedness. The subordinate will invest in the relationship by wanting to bring more knowledge to exchange with the leader, resulting in self-learning behavior. Therefore, leaders need to update and enhance their technical knowledge and skills in their areas of expertise in order to encourage subordinate's learning and innovation. Since an organization's resources should be used wisely and selectively, highly competent leaders are in a good position to critically evaluate ideas in that they are familiar with the technical aspects and details of their subordinate's work. This matches previous research (Andrews and Farris, 1967) that suggests including technical competence among the criteria for choosing supervisors in high-tech organizations. In searching for learning opportunities, we suggest that leaders arrange meetings and workshops to facilitate and increase discussion among employees, with the goal of knowledge sharing by discussing recent or current projects, problems faced, and solutions proposed and their effectiveness.

The results and contributions of this study should be considered in light of its limitations. Three limitations can be pointed out. First, this research focuses only on relationships between leader's technical competence and employee behavior in terms of innovation and learning within the telecommunications industry. While telecommunications cannot be generalized to represent all industries (i.e., low-tech), however, high-tech industries generally have similar characteristics. These include complexity in terms of technology development, fast changing technologies and environment, and high competition (Mendonça, 2009). High-tech industries generally require substantial technical knowledge, learning and innovation from their employees than low-tech industries (Klepper, 2001; Jensen et al., 2007). This assumption is in line with that of previous scholars (Phelps, 2010; Bae and Gargiulo, 2004) who studied the telecommunications industry and generalized the findings to other high-tech industries. Second, we only considered the technical competence of leaders. Other potential variables, such as managerial competence, were not considered. Future research could investigate the combined effect of leaders on innovation and learning among their subordinates. Third, since the focus of this research was on leaders' technical competence, we did not take the subordinate's technical competence into consideration. Future research may investigate whether the impact of the leader's technical competence on the subordinate is influenced by the subordinate's technical competence level compared to the leader.

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