

Wireless information technology competency and transformative leadership in global supply chains: implications for innovative capability

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3 **Wireless information technology competency and transformative leadership in global**
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5 **supply chains: implications for innovative capability**
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7

8 **ABSTRACT**
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10 **Design/methodology/approach**

11 In an exploratory mixed methods approach, the present study collected both quantitative and
12 qualitative data of supply chain relationships from a large global apparel company.
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14 **Purpose**

15 The present study conceptualizes and examines the interplay of transformative leadership,
16 ambidexterity, and wireless information technology competency for enhancing innovative
17 capability.
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20 **Findings**

21 The results show that transformational leaders strongly influence the development of
22 ambidexterity and enhance radical innovative capability through wireless information
23 technology competency.
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26 **Research limitations/implications**

27 The results of this study suggest that supply chain integration through wireless information
28 technology competency can promote simultaneous exploration and exploitation to enhance
29 innovation.
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32 **Practical implications**

33 The growth of cloud and/or virtual supply chains facilitated by digital wireless
34 communications and Internet technology is advancing logistics and supply chain innovations.
35 With increasing global competition, interconnected economies, and ever-growing
36 environmental uncertainty, leadership traits especially transformative leadership and
37 ambidextrous leaders can be major contributing factors for successful development of
38 wireless information technology competency to support innovative capability.
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41 **Originality/value**

42 Wireless information technology competency facilitates knowledge integration particularly
43 for combining prior internal knowledge of exploitative innovation with new external
44 knowledge to develop explorative innovation.
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47 **Keywords:** Digitization, Innovation, Information communication technologies,
48 Ambidexterity
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1. INTRODUCTION

Technological advances in digital communications, cloud computing, Internet and information technology (IT) are facilitating logistics, shrinking market distances and matching market demands through real time response using remote and wireless digital. Wireless information technology has fundamentally altered firms' ability and strategy to implement demand driven supply chains through fast, instantaneous and/or real time market response (Teubner and Stockinger, 2020). For example, digital mobile communications allow companies with global operations and markets to monitor, coordinate and integrate supply chain activities at remote locations and away from distribution centres and headquarters. The emergence of cloud-based supply chains spurred by wireless information technology is accelerating the pace of innovations as well as intensifying cross-border and international competition. With rapid development and application of wireless information technology in supply chain management, firms are able to integrate competencies of supply chain partners (Eng, 2006; Frohlich and Westbrook, 2001), and speed up innovation through real time and remote solutions (Lamberton and Stephen, 2016). Numerous empirical studies have shown that innovative capability is a key determinant of firm performance (e.g., Mone, McKinley and Barker, 1998; Roger, 1995; Sears and Hoetker, 2014).

The supply chain literature has long recognized the use of information communication technologies in supply chain integration (Halldorsson et al., 2015) and innovation within the supply chain network (ISCN) (Arlbjørn et al., 2011). Within ISCN, innovation could be captured using three broad conceptual elements: (1) process (business processes designed and implemented within the focal firm and across supply chain network members, (2) structure (the way in which the network is organized) and (3) technology (technologies applied to enhance efficiency and responsiveness). This supply chain perspective is consistent with the notion of innovation as boundary spanning encompassing digital networks and cloud-enabled

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3 integration of IT systems (Galliers, 1999). A firm can enhance its innovative capability by
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5 simultaneously exploiting and exploring new technologies that promote ambidexterity for
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7 supply chain competitiveness (Cohen and Levinthal, 1990; Tushman and O'Reilly, 1996;
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9 Jansen, Simsek and Cao, 2012; Kang and Snell, 2009). For example, companies offering on-
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11 demand response to consumer preferences and real-time inventory management exploit
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13 technologies (incremental innovation), and/or explore new technologies such as by
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15 developing a new digital delivery platform (radical innovation). This relates to outcomes of
16
17 innovative capability in terms of incremental and radical innovations. The former are
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19 characterized by small changes while radical innovations involved significant changes.
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21 Innovative capability is the ability to make use of existing technologies and/or create new
22
23 technologies through a set of tools in order to support innovation strategies and enhance firm
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25 performance (Burgelman, Christensen and Wheelwright, 2004). It encapsulates the notion of
26
27 transformative leadership with emphasis on new solutions and radical innovations (Jones et
28
29 al. 2008). For example, transformational leaders focus on new solutions and requiring
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31 employee to rethink their assumptions (Christensen and Raynor, 2003).
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38 Innovative capability resulting from transformative leadership depends on the acquisition,
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40 dissemination and use of new knowledge in supply chain integration (Damanpour, 1991;
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42 Moorman and Miner, 1998). Transformational leaders behaviors such as charismatic,
43
44 inspirational and intellectual (Vera and Crossan, 2004) may stimulate explorative and
45
46 exploitative learning to develop wireless information technology competency.
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50 Transformative leaders can be integral for companies implementing change in dynamic
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52 environments (Waldman et al., 2001) especially for global supply chains. Supply chains
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54 consist of interdependent firms, which necessitate learning to access and apply relevant
55
56 external knowledge. Wireless information technology competency can make firms
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58 ambidextrous, and facilitate the combination of exploration and exploitation learning
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3 activities to enhance innovative capability by avoiding path dependent nature of search in
4 explorative learning or a competency trap of exploitative learning (Volberda and Lewin,
5 2003; Ahuja and Lampert, 2001; Leonard-Barton, 1992). In the context of global supply
6 chains, transformative leadership may serve as an overarching strategic behavior for
7 enhanced performance and optimum long-term wealth creation (Caldwell et al., 2011).
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15 However, it remains unclear how wireless information technology competency and
16 transformative leadership affect innovative capability in networked supply chains. Wireless
17 information technology competency can be regarded as a composite dimension of attributes
18 that lead to value creation and sustainability (cf. Wade and Hulland, 2004). Modern
19 networked organizations (e.g., global supply chains) and innovation within the supply chain
20 network (ISCN) necessitate human resource leadership practices to create an environment
21 encouraging individual's knowledge to be used at a collective level benefiting the networked
22 organizations (Mabey and Zhao, 2017). The supply chain context recognizes the importance
23 of leadership in influencing knowledge integration and IT capabilities (Frohlich and
24 Westbrook, 2001; Scarbrough, 2000; Syed, Blome and Papadopoulos, 2020). But few
25 empirical studies examine supply chains innovative capability from the leadership
26 perspective as qualities for supporting wireless information technology competency and
27 ambidexterity. Thus, the present research seeks to fill this gap and analyze the roles of
28 wireless information technology competency and transformative leadership in enhancing
29 ambidexterity and innovative capability.
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49 **2. LITERATURE REVIEW**

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51 A firm's supply chain encompasses all activities associated with the flow and transformation
52 of goods from the raw materials stage (extraction), production, through to the end user, as
53 well as the associated information flows (Handfield and Nichols, 1999). Supply chains
54 possess vital information and repositories of specialized knowledge from specialized inputs
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3 of members in a supply chain. This involves the creation, sharing, application, dissemination,
4 transfer and implementation of information and knowledge embedded in the chain's fabric to
5 transform inputs to economic outputs (Hult et al., 2006) and enhance supply chain
6 performance (Chang, Wong and Chiu, 2019). Supply chain integration spans the entire value
7 system from suppliers to customers requiring the firm increasingly to integrate resources
8 beyond its own boundaries (Combs and Ketchen, 1999; Frohlich and Westbrook, 2001).
9 Supply chain researchers and the Supply Chain Council (see www.supply-chain.org) have
10 stressed the importance of supply chain integration and knowledge (e.g., McGinnis and Kohn
11 1990, 1993). Frohlich and Westbrook (2001) found in their study of international supply
12 chains that a high degree of supply chain integration is strongly associated with higher levels
13 of performance. Hult et al. (2006) also show the importance of knowledge integration to
14 enhance supply chain performance through Miles and Snow's (1978) strategy typologies. As
15 such, knowledge is central to supply chains notably the coordinative and integrative nature of
16 supply chain activities beyond firm and national boundaries for a global supply chain.

2.1. Transformational leadership and ambidexterity

17 Supply chain knowledge must be shared and aligned across the firm's members, transformed
18 and integrated with internally generated knowledge (Fosfuri and Tribo, 2008; Oehlhorn et
19 al., 2020). This process requires the existence of formal and informal mechanisms that
20 promote digital transformation, systems exploitation and alignment through ambidextrous
21 leadership (Tai, Wang and Yeh, 2019; Swart and Kinnie, 2003; Vial, 2019). Exploitation can
22 be defined as the use and refinement of existing knowledge and skills in innovation, whereas
23 exploration refers to the search and pursuit of completely new knowledge and skills in
24 innovation (March, 1991; Benner and Tushman, 2003; He and Wong, 2004; Zhou and Wu,
25 2010). It is well documented that the characteristics of a firm's resources and culture are
26 taught by its leadership and eventually adopted by its followers (e.g., Schein, 1997; Crossan
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3 et al., 1999; Hitt et al., 2001; March, 1991). Transformational leadership behaviors can help
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5 firms to increase their ability to absorb knowledge in contexts of rapid changes (Marion and
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7 Uhl Beir, 2001) and to explore new ideas using mobile technology. The role of
8
9 transformational leadership becomes more critical in knowledge intensive firms to promote
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11 ambidexterity and innovation (Chang, 2015) such as in global supply chains.
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14 Transformational leaders possess behaviors and attributes that challenge the status quo and
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16 promote the more radical learning process of exploration (Bass, 1985; Detert and Burris,
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18 2007). While transformational leaders promote new ways to solve problems, they influence
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20 and connect with followers (Boyatzis and McKee, 2005), gain cooperation and commitment
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22 (Senge, 2006; Vaccaro et al., 2012), and translate intention into reality and sustain it (Bennis
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24 and Nanus, 2007). The latter attribute of sustainable leadership demands ambidexterity in
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26 terms of both a personal transformation of self (Quinn, 1996) and the ability to reframe how
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28 one views the world (Pava, 2003). When leaders commit to ambidextrous learning activities
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30 that require both exploration and exploitation they gain cooperation, trust and followers.
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35 Thus, it can be hypothesized that:

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37 **Hypothesis 1 (H1):** Transformational leadership is positively associated with ambidexterity
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39 in the context of a global supply chain.
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42 **2.2. Transformational leadership and wireless information technology**

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44 Within the knowledge-based view, information technology facilitates integration and
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46 aggregation of knowledge (Grant, 1996). Empirical studies have highlighted the importance
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48 of learning capacity (Hult et al., 2006) and seamless supply chain integration across firm
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50 boundaries in a manner that most competitors cannot easily match (Anderson and Katz, 1998;
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52 Lumus, Vokurka and Alber, 1998) and digitally enabled supply chain integration capabilities
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54 (Ravi, Patnayakuni and Seth, 2006). Transformational leaders strive for organizational
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56 renewal that would support an open culture in order to trigger and facilitate change (Kang et
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3 al., 2015). Such openness is necessary for initiation of innovation in which transformational
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5 leaders may help an organization to explore and exploit wireless information technology
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7 competency. They support cultures conducive to creativity, problem solving, and
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9 experimentation (Bass and Avolio, 1993). Transformational leadership is important to a firm
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11 and its employees' willingness to experiment and apply wireless information technology to
12
13 achieve integrated synergies in a global supply chain. Wireless information technology
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15 competency is a subset of firm IT capabilities (Davies and Brady, 2000) deployed through
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17 transformational leadership to enhance remote access and connectivity to technology
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19 hardware, and execution of software processes. Accordingly, it can be hypothesized that:
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24 **Hypothesis 2 (H2):** Transformational leadership is positively associated with wireless
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26 information technology competency in the context of a global supply chain.
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28 29 **2.3. Information technology competency and ambidexterity**

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31 Firms can enhance their innovative capability by exploring ways to generate radical or
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33 discontinuous innovations while gaining efficiency of exploitation (Christensen, 2006). The
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35 disruptive nature of wireless information technology characterized by unconventional
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37 application enhances explorative learning to produce radical innovations as opposed to
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39 incremental innovations in exploitative learning. Wireless information technology
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41 competency may enhance ambidexterity by disrupting the established routines and enabling
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43 firms to integrate specialized knowledge of different supply chain partners (Cohen and
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45 Levinthal, 1990). Wireless information technology competency can serve to coordinate and
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47 integrate the knowledge of different specialists in the supply chain without fixed physical
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49 constraints (Grant, 1996). Wireless information technology competency extends a firm's
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51 prior and existing knowledge of technology to deploy its resources to achieve specific results
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53 (Ho et al., 2011). One instance in the supply chain is sharing of vital inventory information
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55 while simultaneously develop IT capabilities (Syed et al., 2020) such as through digital
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3 technology where information on extranets can be accessed through wireless devices at any
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5 locations. It can be argued that wireless information technology competency builds on the
6
7 existing information technology competency (Mao et al., 2020) by combining and integrating
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9 dispersed resources. The existing technological capability provides the infrastructure for the
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11 firm to wireless information technology competency to gain exploitative efficiencies as well
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13 as enhance explorative innovations. Thus:
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17 **Hypothesis 3 (H3):** Wireless information technology competency is positively associated
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19 with ambidexterity in the context of a global supply chain.
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22 **2.4. Ambidexterity and innovative capability**

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24 Although the relationship between exploration and exploitation can be paradoxical (March,
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26 1991; Lewis, 2000), both learning processes can co-exist in an ambidextrous organization
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28 (Raisch and Birkinshaw, 2008; Swart and Kinnie, 2010). A firm's innovative capability of
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30 incremental innovation is related to exploitation of existing knowledge whereas radical
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32 innovation is concerned with exploration of new knowledge (Tushman and Anderson, 1986;
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34 Tushman and Smith, 2002). Thus, a high level of innovative capability is likely to produce
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36 radical innovations compared to incremental innovations with a low level of innovative
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38 capability. Empirical studies have shown the simultaneous presence of exploration and
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40 exploitation in manufacturing firm innovation (He and Wong, 2004), customer service teams
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42 using both standardized and creative processes (Gilson et al., 2005), concurrent feedback and
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44 feed-forward learning in mutual fund firms (Bontis et al., 2002), and explorative and
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46 exploitative innovation in financial services (Jansen et al., 2006). These studies show how
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48 firms pursue both innovation processes by altering organizational structures, strategies, and
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50 leadership behaviors (Beckman, 2006; Brown and Eisenhardt, 1997; Gibson and Birkinshaw,
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52 2004). Ambidextrous firms benefit from a high degree of technological scope and diversity,
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54 which is compatible with the notion of distributed (boundary spanning) rather than distinctive
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3 core competencies (Granstrand, Patel and Pavitt, 1997) and the dispersed knowledge in the
4 supply chain to produce complex products, as in 'to know more than they make' (Brusoni,
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6 Prencipe and Pavitt, 2001). An ambidextrous firm simultaneously engages in a high degree of
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8 both exploration and exploitation of wireless information technology competency relative to
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10 its competitors. Within the knowledge-based view, innovative capabilities are the ultimate
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12 organizational outcomes of both exploration and exploitation of external knowledge (Nonaka
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14 and Krogh, 2009; Decarolis and Deeds, 1999). In supply chains, innovative capabilities are
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16 the cumulative results of an organization's overall learning, particularly learning how to
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18 coordinate production technologies dispersed throughout different locations and how to
19
20 integrate diverse technologies (Zhou and Wu, 2010). Extensive empirical studies have noted
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22 that most innovations originate from other internal units of the firm, outside the formal
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24 innovating unit (i.e., the research & development lab) (e.g., von Hippel, 1988; Decarolis and
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26 Deeds, 1999; Jansen et al., 2012) as well as external environment and sources such as supply
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28 chains (e.g., Fosfuri and Tribo, 2008). The ability to exploit external knowledge is a critical
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30 component of innovative capabilities (Pennings and Harianto, 1992). Thus:
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37 **Hypothesis 4 (H4):** Ambidexterity is positively associated with innovative capability in the
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39 context of a global supply chain.
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42 **2.5. Wireless information technology competency and innovative capability**

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44 As a mechanism for coordination and integration, wireless information technology
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46 competency adds to the supply chain literature by enhancing innovative capability (Malhotra,
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48 Gosain and El Sawy, 2005). Wireless information technology competency leverages the
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50 Internet to provide real-time remote access with constantly connected services in the supply
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52 chain. This allows supply chain partners to communicate in real-time, share information and
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54 fulfil market demands in real time at any location. Prior research shows that a firm's
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56 technological capability is positively associated with product innovation (Broadbent, Weill
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3 and Clair, 1999; Nerkar and Roberts, 2004). Specifically, wireless information technology
4 competency increases efficiency by providing users the functionality of access to information
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6 at the point of need in rapid dissemination of information throughout a firm or globally
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8 connected firms (Siau et al., 2001). Advances in wireless information technology competency
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10 can change the established practice in supply chains. For example, wireless information
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12 technology competency is capable of changing the hierarchy of coordination and market
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14 structure (e.g., reintermediation and disintermediation) (Yadav and Pavlou, 2014), the
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16 established product architecture (e.g., interactive consumption) (Christensen, 2006), and the
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18 supply and demand dynamics (e.g., reverse auction pricing). Such efficiency gains in the
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20 supply chain be transformative in terms of explorative learning and a high degree of impact
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22 on the overall supply chain performance. The ability of a firm to connect dispersed supply
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24 chain actors to share and integrate knowledge through wireless information technology
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26 competency renders competitive advantage by creating causal ambiguity and barriers to
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28 replication (Grant, 1996).
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35 **Hypothesis 5 (H5):** Wireless information technology competency is positively associated
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37 with innovative capability in the context of a global supply chain.
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40 Figure 1 depicts an overview of the conceptual model and hypothesized relationships of this
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42 study.
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47 <Take in Figure 1 about here>
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50 51 **3. METHODS**

52 53 **3.1. Research design**

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55 An exploratory mixed method approach was implemented in the present study to gather
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57 evidence of transformational leadership and wireless information technology in supply
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3 chains. The study first conducted quantitative statistical analyses and then followed by a
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5 qualitative analysis of interviews. This approach intended to (a) address the respective
6
7 limitations of each method; and (b) to allow for explanation and validation of statistical
8
9 results. In terms of the former, while testing of the hypotheses shown in Figure 1 may reveal
10
11 important relationships affecting innovative capability of global supply chains, it does not
12
13 explain the mechanisms at work to support innovative capability. For example, ambidextrous
14
15 firms could be enhancing innovative capability based on either exploitative or explorative
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17 learning. But this outcome neither explains how managers engaged in both exploitation and
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19 exploration learning nor how specific leadership qualities support ambidexterity.
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21 Furthermore, qualitative interviews give the opportunity to probe and/or verify evidence from
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23 the statistical results. For instance, examples of wireless information technology competency
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25 can be solicited from supply chain partners in relation to leadership practices.
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30 31 **3.2. Empirical setting**

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33 The study gained access to a large global apparel retailer's supply chains with business
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35 operations spanning the Americas, Europe, Africa and Asia. The study chose the company's
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37 European hub based in the United Kingdom as key for the integration of dispersed global
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39 supply chain activities. The company mainly owns its retail, production and warehouse
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41 businesses while raw materials suppliers, logistics, fashion houses distribution centres, agents
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43 and financiers are external parties forming its extensive supply chains of more over 500
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45 companies of different firm sizes. Although the research design emerges from a single
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47 company, this was deemed appropriate with more than half of the supply chain actors are
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49 external firms. The focus on one company allowed the study to trace the complex nature of
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51 interconnected supply chains in terms of technology application especially for a deeper
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53 analysis of strategic integration of knowledge. In addition, the company's networks of
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55 retailers and warehouses are decentralized, e.g., suppliers in different countries would be
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3 influenced by individual country-specific business requirements such as local competition
4 and regulations. The apparel industry provided a suitable context for the study because of the
5 dynamic nature of apparel business with fast changing consumer demands and intense
6 competition. The apparel industry is characterized by constant introduction of new products
7 and supply chain innovations including both incremental and radical innovations (Jacobides
8 and Billinger, 2006). The deliberate choice of one specific global clothing retailer is also
9 because the company is a leading apparel retailer in the industry, and it has consistently
10 recorded profits in the past five years. These characteristics allow the study to test how the
11 company's leadership influences global operations including employees of other companies
12 or supply actors. In addition, the company's subsidiaries and supply partners based in
13 different countries would be influenced by country-specific requirements (e.g., local
14 competition and regulations), and different product-market requirements.

3.3. Quantitative data

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33 A sampling frame of the study was developed after consultation with the company's chief
34 executive officer in terms of ensuring participants across supply chain functions, external
35 supply chain actors, and supply chain tasks involving diverse technology applications. The
36 sample frame includes respondents holding different senior managerial positions across four
37 supply chain functions at their firm in the supply chain: supply chain planning, product
38 sourcing and procurement, product design and production, and distribution. The
39 appropriateness of an overall function of supply chain management was confirmed by
40 excluding responses with fewer than three in terms of interacting with other supply chain
41 functions. The sample of this study has an average of 3.15 inter-functional coordination of the
42 four supply chain functions. Thus, the respondents from different supply chain actors and
43 functions would be expected to share common goals for the overall supply chain
44 performance. The resulting sample frame comprised 350 target supply chain actors in various
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3 supply chain positions (e.g., supply chain managers, retail managers, purchasing managers,
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5 production managers, marketing managers) as part of the company's supply networks.
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8 With assurance of anonymity and support from the company's chief executive officer
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10 (CEO), a questionnaire in English language was sent via email to all randomly assigned
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12 target respondents. In order to ensure the content and face validity of the measures, the
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14 questionnaire was piloted with 35 senior managers prior to the actual survey, and their
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16 helpful feedback provided minor refinement of wording. English is the main language of
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18 communications at the company especially all target respondents have at least a college level
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20 of education. Following Podsakoff et als' (2003) suggestions to reduce common method
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22 variance, the dependent variable scales (innovative capability) are placed in the midst of
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24 independent variables, response scale anchors are varied, and the ambidexterity scale items of
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26 exploration and exploitation to appear equally valuable. While different supply chain actors
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28 are likely to look after their own business interests, the focus on leadership and innovative
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30 capability of the overall supply system can reduce potential biases from different actors. The
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32 Harman's Single-Factor test (Podsakoff and Organ, 1986) indicated that the extracted four
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34 factors explaining about 80% of the variance in the underlying data and the first factor does
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36 not account for a majority of the variance (32%).
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42 A total of 119 (34 percent response rate) usable questionnaires were obtained after two
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44 rounds of survey with a phone call to non-respondents after a four-week interval. An
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46 independent t-test comparing mean of the study's variables and respondent profiles for the
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48 first 20 and the last 20 respondents revealed no significant differences (at $p < 0.05$) ruling out
49
50 any significant nonresponse bias (Armstrong and Overton, 1977). The data collection activity
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52 took about three months. The final sample of respondents consists of 39 female managers
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54 (33%). The age distribution in the sample (in years) is as follows: 18-25 (18%), 26-35 (19%),
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56 36-45 (37%), and >46 (26%). The profile of education includes college diploma (40%),
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3 bachelor degree (38%), masters degree (14%), and doctorate (8%). The experience of
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5 managers in supply chain operations (in years) comprises: 1-5 (21%), 6-10 (26%), 11-15
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7 (17%), 16-20 (14%), 21-30 (17%), and > 31 (5%). The respondents are representative of
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9 global supply chain actors based in Europe (34%, of which 27% from the UK), Asia (22%),
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11 the Americas (38%), and Africa (13%).
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14 15 **3.4. Measures**

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17 Measures for the dependent and independent variables are based on multiple-item scales
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19 anchored using five-point Likert scales, 1="strongly disagree" and 5="strongly agree". The
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21 innovative capability used anchors of 1="very weaker than competition" and 5= "very
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23 stronger than competition". When available and appropriate, well-validated measures
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25 reported in previous research were used. Churchill's (1979) scale development procedures
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27 and validation methods were followed in item deletion or modification, and measure
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29 development of mobile technological capability. Control variables included in the analysis
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31 were firm size (number of employees), firm age (number of years in operation), sales
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33 performance (total sales in one financial calendar year), and research and development (R&D
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35 investment in one financial calendar year). These variables were included to test their
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37 influence on wireless information technology competency and ambidexterity. The results
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39 showed no significant differences.
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45 *Innovative capability.* Following Tushman and Anderson (1986) and Henderson and Clark
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47 (1990), measure of innovative capability is assessed in terms of incremental innovative
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49 capability and radical innovative capability. This approach provided a basis for assessing the
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51 extent of innovation, which has an implied positive impact on business performance. By
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53 separating incremental innovation from radical innovation, this measure recognizes the
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55 potential of capability-rigidity paradox through path dependence of either exploitative or
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57 explorative learning processes. The two dimensions of incremental and radical innovation
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3 were internally consistent with composite reliability of 0.98 and 0.87 respectively, and their
4 items were interrelated as separate dimensions (see Tables 1 and 2). Table 2 shows support
5 for discriminant validity in that, the square root of the average variance extracted for each
6 variable was higher than its correlations with other variables (Fornell and Lacker, 1981). The
7 six mobile technology capability variables and the seven ambidexterity variables showed that
8 innovative capability factors loaded on a single factor with a clean solution and factor
9 loadings (0.82).

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27 *Transformational leadership* was measured using four dimensions from the 20-item scale
28 transformational leadership scale (Multifactor Leadership Questionnaire Version 5X, Bass
29 and Avolio, 2000) adapted for the context of this study. A factor analysis resulted in the four
30 transformational leadership dimensions (individualized consideration, intellectual
31 stimulation, idealized influence and inspirational motivation) loading satisfactorily on a
32 single, higher order factor for leadership with factor loadings greater than 0.83.

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40 *Wireless information technology competency*. This measure was developed through
41 extensive research on technological capability construct (e.g., Lee et al., 2001; Afuah, 2002)
42 by introducing characteristics of wireless technology particularly for supply chain
43 management (Eng, 2006). Since a strong technological capability foundation (e.g.,
44 investment in state-of-art technologies) is likely to support wireless information technology
45 competency application (Zhou and Wu, 2010), it combines IT infrastructure and extend the
46 existing information technology foundation to the Internet. In developing measurement scale
47 for wireless information technology competency, descriptions about mobile supply chain
48 management, and the use of technology for information and knowledge dissemination in the
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3 supply chain generated a six-item mobile technological capability (see Table 2). The face
4 validity of this measure was assessed by two academics and 13 supply chain managers. This
5 scale was further refined through a pilot study ($N = 35$). The six factors loaded on a single
6 factor as mobile technological capability with Cronbach's alpha of 0.82. The construct
7 showed high reliability (0.88) and convergent validity with factor loadings greater than 0.70.
8 Discriminant validity is supported by a square root of the average variance extracted (AVE)
9 being greater than mobile technological capability's correlation coefficients with any other
10 construct in the model (see Table 2) (Fornell and Larcker, 1981).
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<Take in Table 2 here>

28
29 *Ambidexterity.* Organizational ambidexterity was measured as orthogonal measures
30 comprising four-item of exploitation and three-item of exploration scales derived from
31 previous studies (Nemanich and Vera, 2009; Gibson and Birkinshaw, 2004). The four-item
32 exploitation scale sought to capture incremental improvements to supply chain practices from
33 the use of mobile technology. In the case of the three-item exploration scale, it attempted to
34 capture new supply chain practices and ideas through the use of mobile technology. Scale
35 reliabilities (Cronbach's alpha) for these scales were 0.73 and 0.84 with a difference in terms
36 of average levels 3.17 and 2.94 ($p < 0.001$) respectively for exploitation and exploration.
37 These constructs showed high reliability (greater than 0.92) and convergent validity with
38 factor loadings greater than 0.70. Ambidexterity would be demonstrated with consistent
39 effects of both exploitation and exploration.
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<Take in Table 3 here>

3.5. Qualitative data

The qualitative data collection proceeded after testing the research hypotheses and analyzing the results. This provided the opportunity to seek explanation and contextualize the results. Qualitative interviews were carried out with 11 individuals at the company, which include heads and supervisors across supply chain actors noted above, one head of regional supply chain (Europe), one head of global supply chain and the company's CEO. They were selected because of their responsibility for the company's supply chain activities as well as their knowledge of both operations and strategic supply chain management particularly concerning innovation. The answers from senior managers and their intermediate supervisors can support theoretical sampling for the constructs under investigation. The interviews were conducted individually and facilitated by the company CEO. Each interview lasted approximately one hour and conducted online (e.g., Zoom, Skype) for convenience and cost effectiveness. The interviews were audio recorded with prior consent from the interviewees.

The interviews were guided by similar constructs shown in Figure 1 with an adapted set of prompts to seek clarification and narratives. In particular, the supply chain senior managers were asked to describe the process that supported their supply chain innovative capability. This includes how their senior management team contributed or led to innovation, and how different supply chain actors and functions acquired necessary knowledge related to exploitation and exploration. By asking respondents to describe the process of supply chain innovation they were prompted with questions on abandoning old supply chain practices and radical innovations that can be attributed to their leadership style. They were probed for detailed accounts of selected exploitative and explorative decisions. Respondents were asked to relate to wireless information technology application and provide specific examples of supply chain solutions. If respondents did not provide specific examples of supply chain innovation, they were asked how they contributed or supported other supply chain functions.

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3 Interview data were transcribed by using the interview guide to reduce and categorize
4 data. The researchers maintain good on-going relationships with the company. This enabled
5 the transcribed and coded interviews be verified by the eleven respondents of the study.
6
7 There were no major discrepancies with the content except editing some interview quotes.
8
9 Data analysis of the interview narratives involved an iterative process of moving back and
10 forth between theory and data. The data analysis followed the accepted process of data
11 reduction, pattern analysis and matching, across patterns analysis and identifying emergent
12 themes (Denzin and Lincoln 1994; Miles and Huberman, 1994). Although the process of data
13 analysis appears to be sequential, the actual data analysis began during the data collection
14 process characterized by iteration, refutation, and verification. This process generated
15 relevant themes in corroboration with evidence from the quantitative data analysis. As such,
16 the qualitative data analysis complements the quantitative approach by providing insights
17 through description and explanation.
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32 **4. ANALYSES AND RESULTS**

33 **4.1. Hypothesis testing**

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35 To test the hypotheses, hierarchical regression together with mediation analysis was
36 implemented using Mplus version 6.0. Hierarchical regression allows the analysis of controls,
37 explanatory variables, and linear regression to examine their relative strengths of
38 hypothesized relationships.
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46 Table 3 reports the results of the standardized regression estimates to examine the
47 relationships of transformational leadership, wireless information technology competency,
48 ambidexterity, innovative capability, and control variables. Model 1 shows the baseline
49 model with the control variables. Models 2 to 6 progressively add covariates of independent
50 variables to test each hypothesis. The results of model fit and VIF suggest that the models
51 have adequate fit and multicollinearity is not a threat in the analysis.
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<Take in Table 3>

The results of H1 indicate a statistically significant and positive relationship between transformational leadership and ambidexterity. Model 2 reveals that both exploitation ($\beta = 0.107, p < 0.001$) and exploration ($\beta = 0.159, p < 0.001$) support H1. This observation is consistent with the positive and significant effect of transformational leadership on both incremental and radical innovative capability. Transformational leaders possess behavioral attributes that can help firms to engage in both exploration and exploitation activities, i.e., ambidextrous.

Table 3 shows that model 3 has positive and significant results for H2 ($\beta = 0.104, p < 0.001$), which suggest transformational leadership has a positive relationship with wireless information technology competency. This result is consistent with the attributes of transformational leaders, that open and visionary qualities would increase the potential to explore new technologies.

As model 4 shows, wireless information technology competency has a positive and significant impact on ambidexterity for both exploitation in support of H3 ($\beta = 0.029, p < 0.001$) and exploration ($\beta = 0.043, p < 0.001$). This result is consistent with H5, in that, wireless information technology competency increases the company's supply chain innovative capability.

Hypothesis 4 posits that engaging in both exploration and exploitation has a positive effect on innovative capability. Model 5 confirms consistent positive and significant effects of exploitation on both incremental ($\beta = 0.046, p < 0.01$) and radical ($\beta = 0.258, p < 0.01$) innovations while exploration on radical innovation ($\beta = 0.129, p < 0.001$). Exploration has a negative but non-significant effect on incremental innovation.

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3 In support of H5, model 6 shows the impact of wireless information technology
4 competency on innovative capability is positive and highly significant. Specifically, wireless
5 information technology competency has a more significant influence on innovative radical
6 capability ($\beta = 0.159$, $p < 0.001$) than innovative incremental capability ($\beta = 0.107$, $p < 0.001$).
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8 Thus, wireless information technology competency enhances exploration for radical
9 innovations to a greater extent than exploitation for incremental innovations.
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17 The results of the control variables show only the sales performance is significant and
18 positive. Firms with strong sales performance in the supply chain also have higher levels of
19 innovative capability. Interestingly, the sample of firms in this study with a larger amount of
20 resources dedicated to R&D did not show a positive effect on innovative capability. One
21 explanation is the cross-sectional design of the study lacks the precision to examine R&D
22 intensity. Firms' size and firms' age also do not show any significant effect on innovative
23 capability.
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33 **4.2. Qualitative findings**

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42 As shown in Table 4, the evidence of qualitative data analysis has been examined against
43 leadership behaviors, process and outcomes to verify supply chain innovative capabilities of
44 the company's supply chain operations. This allows the study to cross-check how specific
45 behavioural traits and learning mechanisms support supply chain processes and in turn,
46 innovative capability. The interviews indicated that the company's openness to feedback
47 from employees and customers, and to new technologies is a major determinant of wireless
48 information technology competency in the supply chain. It can be seen that such
49 organizational level behaviors and senior management support relate to transformational
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3 leaders traits particularly willingness to change and rethink the way they work. This may help
4 explain staff motivation to try or recommend new creative technology solutions, as evidenced
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6 by leaders' value in information and making information transparent in the supply chain. The
7
8 respondents echoed that importance of enhanced availability, up-to-date and transparent
9
10 supply chain information. This requires organizational values and norms that accept potential
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12 risks and failures from their venture into new technologies. As a supply chain manager
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14 surmised that the company needs to make fast decision when investing or adopting new
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16 emerging wireless technologies "...there were big bets [in the last five years] but only a
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18 fraction of IT driven supply chain solutions gave us positive ROI after one or two years [...]
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20 now, the question is how do we increase our probability of success with faster decision-
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22 making process [...] so our leaders must respond quickly with the right message and
23
24 attitude."

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31 Exploitative learning that is associated with incremental innovation tended to be
32 supported by the existing established technology rather than emerging technology in the
33 supply chain practice. While the company's leadership has shown to be a major influence on
34 the decision to exploit (rather than explore) technology, the evidence suggests that external
35 pressures together with a conscious investment choice contributed to exploitative decisions.
36
37 In the case of external pressures, the findings point to the industry norms or supply chain
38 technology standards, which led to widespread adoption in supply chain practice. This
39 alignment with the industry can be interpreted as late-to-market in terms of possessing the
40 foresight to invest in selective wireless technology. The adoption of RFID technology for
41 remote tracking and customer service can be considered as industry pressures or at least
42 trends in supply chain practice. The following statement by a supply chain manager illustrates
43 this: "hindsight is useful lesson for us but we would be too late in the game [...] if it is a
44 standard practice we can't hold back the adoption of RFID tracking [...] or we would lose out
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3 to our competitors”. However, the lack of conscious efforts by senior leaders to strategically
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5 select new emerging technologies may also contribute to exploitation or incremental
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7 innovations. For instance, standards point-of-sale (POS) with electronic data interchange for
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9 inventory management systems are safe bets. This reflects leaders who tend to be risk-averse
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11 or choose to follow by adopting established technology. Technology investment in the
12
13 fashion industry characterized by long supply chains can be highly uncertain for supply chain
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15 participants. As represented by a wide consensus in the study, the company’s regional head of
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17 global supply chain said: “We are either in adaptive mode of learning or we have to be
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19 strategic and make substantial technology investments [...] we can’t enter at the
20
21 commercialization and adoption stage of technology [...] still we may have to follow or lose
22
23 our speed to response and that would be costly”.

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28 Compared to exploitative learning characterized by incremental innovations
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30 explorative learning has more in common with transformational leaders’ behavior particularly
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32 they are more inclined to change and disrupt stable practices. Such leaders would be more
33
34 willing to support independent and risky IT projects or investments with knowledge that their
35
36 investment may result in losses or no returns. As mentioned earlier, top management support
37
38 is crucial for successful adoption and pursuit of IT based supply chain solutions. One senior
39
40 manager of the company’s supply chain said: “The commitment and support from our senior
41
42 leaders are very important when new technology is unknown in the marketplace [...] it can
43
44 take two years or longer before we even see how the technology would work and assess the
45
46 ROI”. The decision to explore or make major changes was usually informed by market
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48 intelligence, competitor analysis, opinion leaders and supply chain stakeholders such as
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50 technology suppliers. Explorative initiatives shared a common outcome that it has a high
51
52 failure rate. One senior manager summed this up in the following statement: “we don’t have a
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54 crystal ball to continuously come up radical innovations [...] sometimes it is our conscious
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3 decision to follow other major player [...] we are a market leader but I can't say for certain
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5 we are sprouting out radical innovations all the time [...] I can say we do most of the most of
6
7 the time [...] that's how we command the market". Supply chain innovative capabilities
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9 enhanced the company's performance and required a longer-term horizon in supply chain
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11 planning and implement. Although it was not referred to explicitly, it is implied that radical
12
13 innovations generated above normal returns and/or first-mover competitive advantage.
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17 Both exploitation and exploration strategies can be attractive or even operate at the
18
19 same time, as far as ambidexterity is concerned. While exploitation tended to be a reactive
20
21 response to the market (e.g., external pressures), exploration had been shown to be a strategic
22
23 choice. Exploration is synonymous with the notion of high risks, high returns, which can be
24
25 influenced by transformative leadership. For example, a successful radical innovative supply
26
27 chain solution is the result of a self-select decision to make significant investments in future
28
29 technology. Wireless information technology competency in the company's global supply
30
31 chain operations is based on a deliberate and selective process of decision-making. In the
32
33 words of the company CEO: "where and how we spend our money on new technology is not
34
35 based on a creative genius [...] our knowledge of the market and how supply chain works
36
37 come from investment in learning [...] of course we tried to be out there first [...] every
38
39 investment requires managers to validate innovative cases extensively in a supportive manner
40
41 [...] I am quite proud of our efforts to develop this culture." The company reported the
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43 importance of commitment and trust in their supply chain decision apart from making
44
45 selective choices based on extensive cost and strategic analyses. Collectively, one common
46
47 explanation noted by the respondents is the idea of hedging (rather than balancing) between
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49 exploitation and exploration. This observation reflects ambidextrousness concerning short-
50
51 term gains of exploitation and long-term supply chain innovations through exploration.
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58 Instead of treating these types of learning as opposing mechanisms between incremental and
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3 radical innovations, one explanation of technology-based innovations benefit from both
4 specialized radical innovations with market premiums through exploration, and general with
5 market wide incremental innovations through exploitation. This explanation is reinforced by
6 comments from a senior supply chain manager: “Some firms try to be ahead of the curve
7 (innovation) and invest heavily in exploration [...] some outright followers [...] we’ve been
8 selective by specializing in rapid response technology but things don’t always stay that way
9 [...] we’ve seen into some remarkable efficiency gains from exploiting current technology”.

19 **5. DISCUSSION**

21 **5.1. Implications for theory**

23 Transformational leadership has been shown to support ambidexterity and mobile
24 technological capability. Although transformative leaders have challenging tasks, they seek
25 new solutions that require them to abandon old ways and adopt new ways to solve problems.
26 Within the knowledge-based view, the application of wireless technology to integrate
27 specialist knowledge and gain awareness of expertise in the supply chain may increase
28 absorptive capacity and enhances innovative capability. The results of this study show that
29 wireless information technology competency have a positive effect on both radical and
30 incremental innovations. It has a strong influence on radical innovative capability such as
31 through on-demand response to fashion trends, cloud technology permitting remote access to
32 live customer data, and real time inventory management. As Zhou and Wu (2010) point out
33 in their study, the existing technological capability may help the firm to quickly identify new
34 technological trends but the increasing accumulation of technological capability may also
35 cause the firm to form a unique set of organizational routines that likely to limit its
36 explorative innovation. This study shows that wireless information technology competency
37 support the process of exploration for radical innovation, which complements the existing
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3 and prior technological capability for exploitation (Cohen and Levinthal, 1990) and the
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5 notion of IT ambidexterity (Syed et al., 2020).
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8 As transformational leadership capable of building trust and commitment in an
9
10 organization (Vaccaro et al., 2012), this attribute of personal connection between the
11
12 organization and its members would help the organization to explore and exploit new
13
14 technology. The results show that wireless information technology competency has the
15
16 potential to disrupt the established structure of communication between the firm and its
17
18 external environment, i.e., as environmental triggers. This has implications for the notion of
19
20 potential absorptive capacity, which focuses on the interface between the firm and its
21
22 environment (Zahra and George, 2002) in terms of the role of wireless information
23
24 technology competencys well as in acquiring absorptive capacity (i.e., R&D is not
25
26 necessarily a by-product).
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31 The wireless element of technological capability can contribute to ambidexterity such as
32
33 through real time response to market demands and process automation for live inventory data.
34
35 The results of this study suggest that supply chain integration through wireless information
36
37 technology competency can promote simultaneous exploration and exploitation to enhance
38
39 innovation. According to the concept of absorptive capacity, a shock in supply chains such as
40
41 a shift to wireless technology can induce a firm to search, assimilate and make use of
42
43 externally generated information (Bessant et al., 2005; Fosfuri and Tribo, 2008). Wireless
44
45 information technology competency has implications for knowledge aggregation. It facilitates
46
47 knowledge transmission where firm boundaries can be dynamic rather than static, and hence
48
49 access to knowledge is not constrained by time and place. Such efficiency of knowledge
50
51 aggregation enabled by wireless information technology competency reflects the firm's
52
53 ambidexterity. Prior research has shown that the breadth and the depth of outside knowledge
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55 exposure (mobile technology) positively influence a firm's propensity to explore new and
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3 related external knowledge (Van Wijk, Van den Bosch and Volberda, 2001). Moreover,
4
5 wireless information technology competency has a high degree of technological scope and
6
7 diversity from numerous opportunities to apply and integrate knowledge in supply chains
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10 (Andriopoulos and Lewis, 2010).
11

12 **5.2 Implications for practice**

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14 Knowledge management in the context of networked organizations is a major challenge for
15
16 HRM (Mabey and Zhao, 2017). In this context, HRM needs to promote distributed style of
17
18 knowledge exchange embedded in interdependent organizations (Marion and Uhl Bein,
19
20 2001). Managers must realize that while their organization may invest in latest and most
21
22 advanced technology they would benefit from nurturing transformational leaders. Not to
23
24 mention, investment in wireless information technology can be costly as well as complex in
25
26 terms of challenges in implementation (Eng, 2006). The results of this study suggest that
27
28 transformational leadership can enhance ambidexterity and the use of mobile technology in
29
30 supply chain. For example, the commitment of transformational leaders to organizational
31
32 performance and personal improvement would help their organization to be ambidextrous
33
34 and use technology in supply chain integration. Wireless information technology
35
36 competency can have major impacts on supply chain operations with real time accessibility to
37
38 critical supply chain information (e.g., live inventory levels and product performance), timely
39
40 and accurate customer services (e.g., product specification and tracking), and any location
41
42 coordination and integration (e.g., flexible and adaptable boundary). Managers must actively
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44 search for knowledge beyond internal units and/or functions while exploiting local
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46 knowledge stores. As shown in this study, wireless information technology competency
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48 application has a more significant influence on radical innovation than incremental
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50 innovation. The capability of wireless information technology competency reflects the notion
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52 of distributed distinctive core competencies (Granstrand, Patel and Pavitt, 1997), which
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3 recognizes the complexity and causal ambiguity inherent in broad scale knowledge
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5 integration (Grant, 1996) such as the global supply chain operations of this study. The results
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7 also suggest that short-term R&D investment (e.g., one-year of R&D investment recorded in
8
9 this study) may not have an impact on innovative capabilities. Thus, firms must be strategic
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11 in building technological capacity from cumulative knowledge while seeking collaboration
12
13 in building technological capacity from cumulative knowledge while seeking collaboration
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15 with external supply chain partners, which more likely to lead to acquisition of new
16
17 knowledge.

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19 In a global supply chain, transformational leadership enhances ambidexterity for the
20
21 integration of dispersed supply chain functions and activities. The attributes of
22
23 transformational leaders can help organizations to create new technological standards and
24
25 rules imposed by wireless information technology competency regulate the interactions
26
27 between a firm and its large number of supply chain partners. This provides a means by
28
29 which tacit knowledge can be converted into readily comprehensible explicit knowledge
30
31 between specialists (Demsetz, 1991), and hence wireless information technology competency
32
33 increases the ability of a firm to integrate new knowledge and exploit relevant opportunities.
34
35 Managers must understand standards of the existing technological platform in which their
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37 technology investment is scalable (e.g., Chandra, Kumar and Smirnov, 2001) to ensure new
38
39 wireless information technology competency capable of embedding industry standards for
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41 cross-border and global communications (e.g., Vialle, Song and Zhang, 2012). Such
42
43 interdependence relies on managers to evaluate technologies for seamless coordination and
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45 integration of knowledge. Managers should focus on integration of specialized knowledge in
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47 supply chains where efficient knowledge utilization for innovative activities shifts rigid
48
49 organizational hierarchies to fluid and dynamic characteristics of wireless information
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51 technology competency such as in virtual chains. This resonates with today's wireless and
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53 connected employees and global supply chains. Thus, the role played by absorptive capacity
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3 changes continuously, and absorptive capacity impinges at different times on different
4 capabilities and routines (Zahra and George, 2002). Grant (1996) also points out a firm's
5 organizational capability depends more upon the firm's mechanisms of knowledge
6 integration rather the extent of specialist knowledge which employees possess in the context
7 of mobile employees.
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14 **5.3. Limitations and Future research**

16 This study proposed and examined that transformational leadership influences wireless
17 information technology competency and ambidexterity and in turn, innovative capability in
18 the context of global supply chain management. Although the research attempted to focus on
19 leadership and wireless technology of global supply chain participants, data collection
20 constraints as regards time, research budget and access restrictions of the company's supply
21 chain networks could have prevented the study from collecting data to control for types of
22 wireless technology applications in the supply chain as well as generalizability beyond one
23 industrial sector. For example, the four key functions of supply chain management may
24 require different technological capabilities in relation to the overall performance. Future
25 research is needed to replicate the study in different business contexts and to determine
26 specific transformational leadership attributes and wireless information technology
27 competency supply chain management. In addition, research is needed to examine the
28 influence of cultural differences and leadership styles which could influence ambidexterity.
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46 This research conceptualized wireless information technology competency as an
47 independent construct. Since a new measurement scale is developed to capture wireless
48 technology application in supply chain management, further research would need to continue
49 this effort to refine theoretical conceptualizations and improve generalizability to other
50 sectors apart from the clothing and apparel industry. Given the significance of this construct
51 in influencing ambidexterity and innovative capability, future research might identify
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3 antecedents of wireless information technology competency using both technological and
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5 organizational perspectives. For example, organizational practices such as openness to new
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7 technologies, research and development, and lateral thinking in technology application may
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9 help to support wireless technology innovations, apart from exploring the potential of new
10
11 mobile technologies.
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14 A key contribution of this study is the positive effect of transformational leadership on
15
16 wireless information technology competency and ambidexterity, which adds to organizational
17
18 behaviours that transformational leadership is under-explored in supply chain management
19
20 for developing innovative supply chain solutions. Since this study reveals that wireless
21
22 information technology competency support ambidexterity and innovative capability, future
23
24 research will benefit from how certain organizational behaviors and structures complement
25
26 transformational leadership behaviors. This line of research enquiry may add to knowledge
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28 about the role of organizational structure in terms of how both leadership behaviors and
29
30 ambidexterity enable fluid and dynamic flow of information across layers of organizational
31
32 hierarchy, and hence influences knowledge appropriability. Further research is also needed to
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34 examine how wireless information technology competency can be developed between firms
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36 to support exploration and exploitation. For example, in-depth case studies may help to shed
37
38 new light on the interaction between wireless information technology competency and
39
40 ambidexterity.
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46 **6. CONCLUSION**

47
48 Drawing on the knowledge-based view and leadership literature, innovative capability of
49
50 global supply chains is conceptualized as a consequence of organizational ambidexterity and
51
52 learning through wireless information technology competency (see Nonaka and Krogh, 2009;
53
54 Sabherwal and Bercerra-Fernandex, 2003). Accordingly, the focus is on knowledge outcomes
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56 of leadership attributes and dynamic capabilities (wireless information technology
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3 competency and ambidextrous activities) as enhanced absorptive capacity to develop
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5 innovative capability. This study shows that transformational leadership contributes to supply
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7 chain innovative capability and organizational ambidexterity through wireless information
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9 technology competency in the context of global supply chains. It extends the focus of
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11 leadership concepts on attributes to resources and the knowledge-based view on internal
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13 knowledge creation by revealing the importance of transformational leadership behaviors in
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15 implementing mechanisms to enhance firm performance. In this instance, wireless
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17 information technology competency facilitates knowledge integration particularly for
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19 combining prior internal knowledge of exploitative innovation with new external knowledge
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21 to develop explorative innovation. The enhanced efficiency of wireless technology (e.g.,
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23 knowledge aggregation) through mechanisms of interface between the firm and its
24
25 environment contributes to the notion of potential absorptive capacity (e.g., a firm's
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27 receptiveness to knowledge) and to realized absorptive capacity (e.g., an improved capacity
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29 to apply absorbed knowledge). Thus, the present study offers new insight into the basis for
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31 enhancing innovative capability that contributes to a supply chain's innovative capacity – in
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33 this case through wireless information technology competency to enhance ambidexterity and
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35 supply chain innovative capability.
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Figure 1
Conceptual model

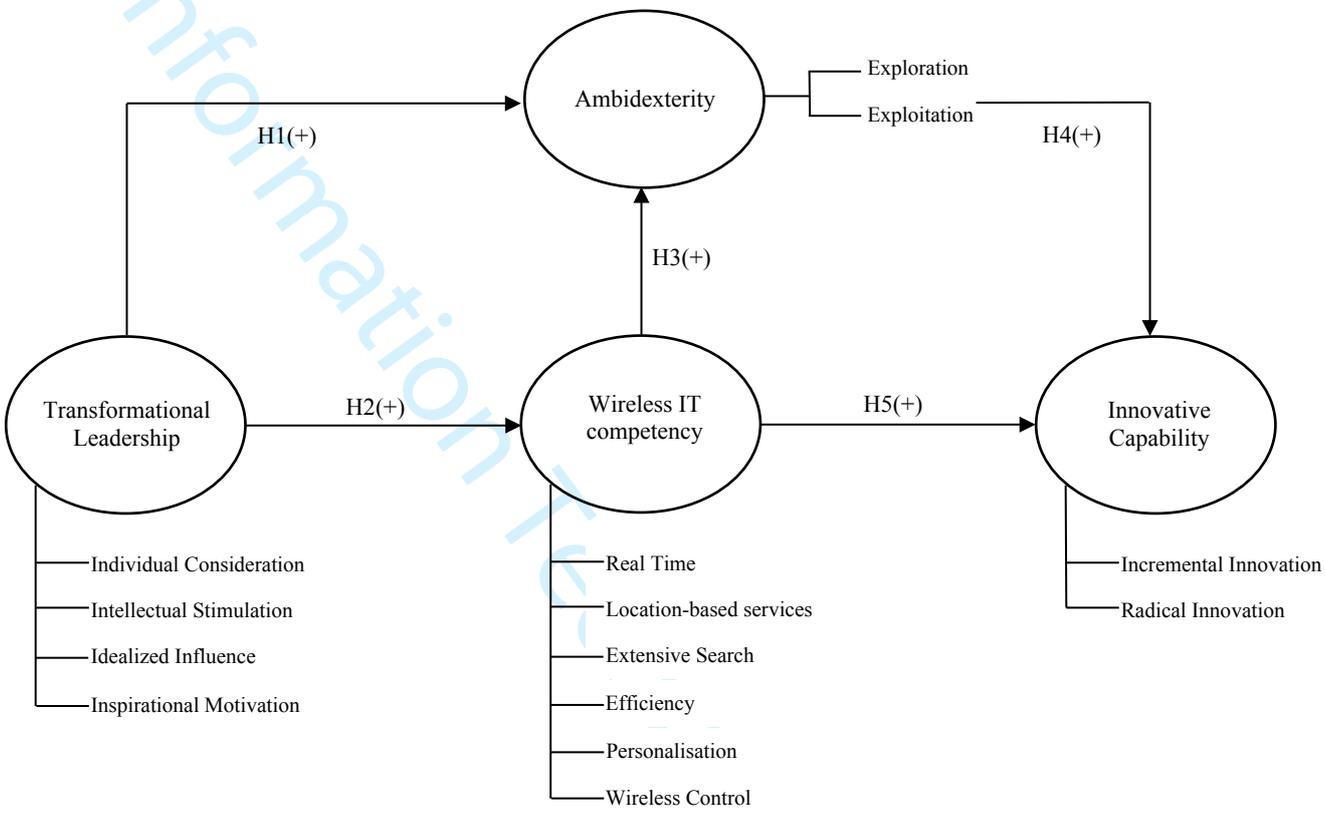


Table 1
Means, standard deviations and correlations

Variables	mean	SD	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Supply chain management	3.15	.18	.27**	.28***	.31**	.48	-.15	.12	.42	.27**	.19	.29**	.34**	.01	.02	.25	.17***
2. Supply chain planning	.14								.26	-.12	.00	-.06	-.12	.00	.17	.12	.18
3. Product sourcing and procurement	.12								.13	.25	.17*	-.24	.02	.05*	.01	.00	.20
4. Product design and production	.17								.18	-.27	.21	-.21 ⁺	-.01	.02*	-.02	.13	-.12
5. Distribution	.18								.19	.18	-.15	.13	-.02	.04	.01	.20	.18
6. R&D investment	.20								.318	.27	.031	-.022	.026	-.017	-.012	-.24	.10
7. Firm size	.17								.04	.02	-.03	.02	-.04	.03	.02	.15	-.05
8. Firm age									.02	.01	.06	.00	.05	.03	.01	.07	.04
9. Sales									.06	.00	.03 ⁺	-.07	-.04	.11**	.00	.01	.00
10. Wireless IT competency	3.62	.54										.34**	.32**	.09**	.13**	.26***	.15**
11. Incremental innovative capability	3.65	.19											.30	.21***	.36	.29**	.25
12. Radical innovative capability	3.15	.75											.29	.18***	.33***	.10	
13. Leadership	4.08	.62													0.16**	.26***	.12**
14. Exploitation	3.17	.29														.11**	-.8**
15. Exploration	2.94	.26															.24***
16. Ambidexterity	2.67	.12															

N = 119

⁺ $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$.

Table 2
Results of confirmatory factor analysis

Variables		t-values	Cronbach's alpha α	Composite reliability
Transformational leadership			.94	.85
We get to spend time sharing practices with our employees.	.72	4.221		
Our organization considers our individual strengths and abilities.	.78	3.143		
We get to change and rethink the way we work in the supply chain.	.83	4.160		
Our employees ask questions to improve supply chain operations.	.86	3.141		
Our superior leads by example.	.69	4.531		
We consider our superior as a good role model for us to follow.	.75	3.893		
We aspire to high standards in delivering our supply chain performance.	.85	3.751		
We talk optimistically about our services.	.75	4.091		
Average Variance Extracted	64%			
Wireless information technology competency			.82	.88
There is real time coordination in our supply chain.	.75	3.616		
Our supply chain offers location-based services.	.72	4.821		
We rely on wireless technology to achieve extensive reach in supply chains.	.84	3.870		
We achieve coordination and integration efficiency using mobile technology.	.78	4.023		
Our personalization service is enhanced by mobile technology.	.72	3.840		
Wireless technology is seen as vital for our supply chain responsiveness and competitiveness.	.80	4.583		
Average Variance Extracted	54%			
Ambidexterity			.73	.94
Exploitation				
We add value to our supply chain by quickly adapting existing mobile technologies.	.91	3.446		
We add value to our supply chain by modifying and improving the way we operate using mobile technologies.	.82	4.851		
We adopt new mobile technologies by learning what has worked for others in our supply chain.	.85	5.791		
	.78	5.610		

We use established mobile technology to execute efficient processes in our supply chain.				
Average Variance Extracted	74%			
Exploration			.84	.92
We implement most new mobile technologies in our supply chain.	.86	7.013		
We use mobile technology to share and develop new tools in our supply chain.	.80	5.111		
We encourage the use of mobile technology to experiment new ways to organise and manage supply chains.	.86	5.819		
Average Variance Extracted	68%			
Innovative capability			.82	.98
Incremental innovative capability				
We develop innovations that reinforce supply chain competencies.	.87	3.591		
We achieve innovations that reinforce existing functions in the supply chain.	.82	5.801		
We develop innovations that reinforce how we currently compete in the supply chain.	.76	7.840		
Average Variance Extracted	72%			
Radical innovative capability			.85	.87
We achieve innovations that make prevailing processes in the supply chain obsolete.	.76	4.881		
We achieve innovations that fundamentally change existing functions in the supply chain.	.77	5.976		
We develop innovations that make existing skills and knowledge in the supply chain obsolete.	.83	4.802		
Average Variance Extracted	75%			

Note: Model fit statistics: $\chi^2 = 251$; d.f. = 190; $p = 0.05$; Incremental fit index (IFI) = .92; Comparative fit index (CFI) = .89; Non-Normed fit index (NNFI) = .94; Root Mean Square Error of Approximation = 0.048

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Table 3
Results of hierarchical regression

	Dependent variable									
	Model 1	Model 2		Model 3	Model 4		Model 5		Model 6	
		Incre.	Radical	Mobile technology application	Exploitation	Exploration	Incre.	Radical	Incre.	Radical
R&D investment	.020 (.500)	-.001 (-.220)	-.003 (-.270)	.012 (.400)	-.007 (-.263)	-.001 (-.041)	-.003 (-.301)	-.002 (-.401)	.010 (.470)	-.001 (.825)
Firm size	.021 (.530)	.013 (.310)	.010 (.380)	-.019 (.450)	-.004 (-.372)	-.007 (-.273)	-.002 (-.274)	-.004 (-.217)	.006 (.361)	.015 (.681)
Firm age	.031 (.053)	.0015 (.021)	.0054 (.520)	.049 (.053)	.017 (.180)	.014 (.210)	.018 (.190)	.026 (.208)	-.025 (-.288)	.028 (.414)
Sales performance	.219 10.050)	.149*** (6.180)	.164*** (6.180)	.129 (11.210)	.164*** (6.910)	.218*** (4.810)	.153*** (7.285)	.103*** (4.952)	.374 (13.174)	.619 (9.814)
Transformational leadership		.191*** (3.915)	.292*** (4.826)	.104*** (6.761)						
Wireless IT competency					.029** (7.501)	.043*** (4.831)			.107*** (4.521)	.159*** (7.492)
Exploitation							.046** (3.270)	.258** (4.271)		
Exploration							-.018 (2.286)	.129*** (3.186)		
Ambidexterity										
Maximum VIF	4.628	5.916		5.121	4.681		3.732		4.192	5.190
F-value	12.627	15.107***		19.523	15.016***		15.218***		17.189	18.226
Adjusted R²	.318	.479		.012	.611		.719		.016	.027

N = 119 for all models; Standard errors are in parentheses.

⁺p < .10 *p < .05 **p < .01 ***p < .001.

Table 4
Main Qualitative Findings

	Transformative leadership behaviors	Process	Supply chain innovations
Wireless information technology competency	Receptive, Open and willing to listen, Seek feedback from employees and customers, Information technology driven, Adventurous	Teams on lookout for new technologies, Collaborate and partner with IT companies, Use new technology to shorten supply chain and reduce variability	Supply chain information availability on mobile devices, Sharing live data on location and goods in transit, Connect with suppliers and end users, Integrate mobile features, e.g., touch screen and voice control.
Exploitation	Adopt existing technologies, Risk-averse attitude or wait-and-see for certain technology, Align with industry practice, Tech followers (not leaders)	Planning production and inventory, Adaptive learning to reduce human errors, Investments require more certain ROI, Demand forecasting	Point-of-sale technology (POS) and electronic data interchange (EDI), Radio-Frequency-Identification (RFID), Computer Aided Design (CAD), Low cost and tech solutions
Exploration	Creativity, Independent projects, Dare to disrupt current process, Top management support	Self-select to apply new technologies, Listening and responding to the market, Prioritise long-term benefits while manage short-term constraints	Personalized approach based on filtering technology, Smart tag on individual garments, Overcome bullwhip effects
Ambidexterity	Analytical and strategic about choices, Invest in short- and long-term solutions, Develop new relationships and terminate redundant relationships, Expand and grow networks	Commitment and trust, Focus on both generalist and specialist capabilities, Cost-based decisions and strategic investment based on future scenarios, Technology and data driven solutions	Hedge, e.g., early and late mover advantages, Flexible XML standards, Database supply chain management, Synchronized supply chain, Avoid shortage gaming from seasonal effects

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