Unpacking the Value of Supply Chain Integration and Innovation Ambidexterity in Promoting Business Sustainability and Brand Image: Implications for B2B Manufacturing Firms in a Next-Eleven Emerging Country

Seyed Mahdi Vesal

B. Eng., MBA

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Abstract

Increasing resource consumption and pollution, and their detrimental effects on the environment are forcing firms across the globe to adopt strategies directed at sustainability. This is especially so for business-to-business (B2B) manufacturing firms operating in emerging countries who intensively use natural resources in their operations and are blamed for observable impacts on the environment. Sustainability when viewed from a business perspective is defined as an organizational[1] activity that is directed to reducing pollution and efficient use of energy and other resources aiming at diminishing the detrimental effects of firms' activities on the environment and human race. In an attempt to address the challenges that sustainability is raising, innovation is promoted as an especially important solution.

In the pursuit of innovation, a widely acknowledged approach toward categorizing innovation is via the notions of radical and incremental innovation. While radical innovation involves substantial changes in technical skills, knowledge, and design, incremental innovation improves on a known product or the process for producing it, reinforcing existing engineering and manufacturing know-how. However, little emphasis has been given to unpacking the mechanisms by which radical and incremental innovation, when managed ambidextrously (hereafter referred to as innovation ambidexterity) drive sustainability. In addition, while marketing literature has focused on the necessity of transitioning toward sustainability, far less attention has been given to uncovering whether the investments necessary for B2B firms to adopt sustainability practices pay off in terms of improving their brands as a major marketing asset. Accordingly, this research examines the role of innovation ambidexterity in the sustainability of B2B manufacturing firms operating in emerging countries, as well as factors

[1] The thesis is written using American English rather than Australian English. This has been adopted to present the thesis in the same language as the journals that chapters 2, 3 and 4 have been submitted to. To be consistent, the same language (US English) is used across the whole thesis.

that support innovation and whether the pursuit of sustainability helps these firms in building strong brands and improving their long-term performance.

This research adopts a thesis by publication format and comprises three inter-related but distinct papers. The first paper draws on organizational ambidexterity theory to investigate the relationship between innovation ambidexterity and sustainability in manufacturing firms operating in emerging countries. To unpack this relationship, this paper brings critical attention to the contingent role of CEOs' leadership style and business unit managers' attitudes toward sustainability. To test the theory, this paper uses a multi-informant dataset collected from production managers and supply chain managers in business units of manufacturing firms. The results show that innovation ambidexterity is a trigger for driving a firm's ability to pursue sustainability goals. Further, the results demonstrate that CEOs' leadership style and business unit managers' attitudes toward sustainability enhance the positive effect of innovation ambidexterity on sustainability. This paper advances the current literature on innovation and sustainability by delving into how firms can ambidextrously manage their radical and incremental innovation to support sustainability activities.

The second paper brings signaling theory into the sustainability literature with a specific focus on emerging countries and explores the extent to which a firm's pursuit of sustainability underpins its ability to create a positive brand image, which in turn, promotes its market performance. In addition, this paper examines the roles of customer relationship management (CRM) and business customers'[2] attitudes toward sustainability as keys to foster the relationship between sustainability practices and brand image. The dyadic data for this paper comes from cross-industry B2B firms and their customers. The findings reveal that sustainability practices significantly influence the generation of positive brand image perceived

[2] Given the current research's focus on business customers, hereafter in Chapter 1, business customers are referred to as customers.

by customers and this relationship is significantly improved through use of CRM practices and customers' holding favorable attitudes toward sustainability. In doing so, this paper extends the boundaries of sustainability research and offers appropriate strategies for B2B firms to better direct their attention to sustainability practices in driving brand success and improve long-term performance.

The third paper integrates the relational view and organizational ambidexterity theories and investigates how the individual and combined effects of supplier integration (SI) and customer integration (CI) help firms in emerging countries generate both radical and incremental innovation. In addition, this paper articulates the moderating role of internal integration in enhancing the relationship between external (supplier and customer) integration and radical and incremental innovation. Empirical support for the proposed effects comes from a triadic matched, multi-stakeholder (focal firms, suppliers and customers) design from broad range of industrial firms in the manufacturing sector. The findings indicate that SI and CI are not equally beneficial in driving both radical and incremental innovation. Moreover, the findings highlight the significant role of internal integration in improving the effects of external integration on radical and incremental innovation. The findings of this paper provide new insights for firms to manage available resources and capacities to integrate suppliers and customers into their operations to ensure they maximize innovation and performance.

Overall, through the three papers, the thesis advances the literature by providing novel theoretical explanations to understand the determinants of innovation and sustainability across the supply chain, as well as the contribution that sustainability practices make to achieving superior brand image and organizational performance in emerging countries.

Statement of candidate

I certify that the work embodied in this thesis, ***Unpacking the Value of Supply Chain Integration and Innovation Ambidexterity in Promoting Business Sustainability and Brand Image: Implications for B2B Manufacturing Firms in a Next-Eleven Emerging Country*** has not previously been submitted for any other higher degree to any other university or institution other than Macquarie University. To the best of my knowledge, the thesis contains no material previously published or written by another person except where due reference is made. The co-authors included in earlier versions of Chapters 2, 3 and 4 were involved in the research at a supervisory level.

The research presented in this thesis was approved by University of Tasmanian Ethics committee (Reference number: H0015411, on 23rd of December, 2015) and transferred and approved by Macquarie University Ethics Review Committee.

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Chapter 1

Introduction

1.1 Background

Depletion of natural resources and growing concerns over environmental pollution, coupled with the push from environmental protection agencies and governments to manage environmental change have forced many firms to adopt strategies directed at sustainability (Esfahbodi, Zhang, & Watson, 2016; Yusuf, Gunasekaran, Musa, El-Berishy, Abubakar, & Ambursa, 2013). This is especially so for business-to-business (B2B) manufacturing firms operating in emerging countries whose operations require significant consumption of energy, natural resources and place a greater burden on the environment (Sheth & Sinha, 2015). The growing range of issues related to sustainability have given rise to a burgeoning body of research on sustainability and how to dampen unstainable production growth, control pollution, and resources depletion (e.g., Boons, Montalvo, Quist, & Wagner, 2013; Silvestre, 2015; Wang, Subramanian, Gunasekaran, Abdulrahman, & Liu, 2015). Sustainability, when viewed from a business perspective is defined as an organizational activity that is directed to reducing pollution and efficient use of energy and other resources aiming at diminishing the detrimental effects of firms' activities on the environment and human race (Gupta & Kumar, 2013).

The positive consequences of sustainability have encouraged many firms operating in B2B markets to engage in activities that they believe will support sustainability (Kumar & Christodoulopoulou, 2014; Sharma, Iyer, Mehrotra, & Krishnan, 2010). However, it appears many of the processes and products produced by B2B firms still negatively affect sustainability. For example, production processes in the fossil fuel industry and its final products (as the main energy sources of other industries) accounted for approximately 91% of global industrial greenhouse gases in 2015 (Griffin, 2017). The raft of scientific data available has raised concerns for many B2B manufacturers about the negative impact of their activities on the environment including, but not limited to excessive consumption of natural resources, environmental degradation, and increased waste (Sheth & Sinha, 2015). Accordingly, many

B2B firms have started changing not only the products they produce, but also their production processes and managerial practices to better support sustainability practices (Mariadoss, Tansuhaj, & Mouri, 2011).

A key activity that appears to provide solutions to address challenges related to sustainability is innovation and doing things differently (Boons et al., 2013; Klewitz & Hansen, 2014; Silvestre, 2015). Innovation may foster methods that enable firms to more efficiently use resources and reduce damage to the environment through new or improved operations, production processes and products. One of the widely adopted approaches toward categorizing innovation is radical and incremental innovation (e.g., Fernhaber & Patel, 2012; Lin, McDonough, Lin, & Lin, 2013). Radical innovation involves fundamental changes in procedures leading to a switch from existing processes and products to those that are new to a firm or industry (Fernhaber & Patel, 2012). Incremental innovation, in contrast, involves improving and refining established procedures and leads to relatively minor adaptations of existing processes and products (Fernhaber & Patel, 2012). Prior research has acknowledged that either of these innovation forms incorporates advantages (positives) and disadvantages (negatives) (e.g., Fernhaber & Patel, 2012). More recently, researchers such as Lin et al. (2013) and Tan and Liu (2014) have suggested that if a firm can pursue both radical and incremental innovation simultaneously, it is possible that together the positives of these innovation forms can compensate for the negatives each has and may just be the trigger to achieve greater success. The firm's ability to pursue both radical and incremental innovation is linked to the concept of innovation ambidexterity (Chang & Hughes, 2012; Lin et al., 2013). Although innovation ambidexterity has been shown to enhance performance across a wide range of areas, the underlying mechanism that demonstrates whether innovation ambidexterity tackles rapidly growing energy and environmental challenges in B2B manufacturing sector is still unknown.

Furthermore, although challenges such as resource exploitation and environmental degradation resulted from B2B manufacturing firms' operation in emerging countries can threaten their position with loss of trust and legitimacy (Sheth & Sinha, 2015), in turn, they can give rise opportunities for these manufacturers. The underlying reason is that business customers are becoming more concerned with and favor firms with higher commitment to sustainability (Gupta & Kumar, 2013; Kumar & Christodoulopoulou, 2014). The focus on sustainability consciousness by business customers manifests itself in persuading B2B firms to invest in sustainability as part of their core business strategies (Sharma et al., 2010). For instance, recent reports note that in 2016 BHP Billiton and Caterpillar have invested $10.5 and $2.3 million, respectively on activities related to sustainability such as environmental remediation and industrial energy management (BHP Billiton Sustainability Report, 2016; CATERPILLAR Sustainability Report, 2016). However, despite studies highlighting the implications of adopting sustainability to improve marketing assets (e.g., Kumar & Christodoulopoulou, 2014; Sheth & Sinha, 2015), it is not clear whether investments in sustainability actually payoff for B2B firms in terms of improving their brands as a major intangible asset or the extent B2B brands contribute to market performance.

Taken together, to better understand the subtle and complex processes through which B2B firms achieve and benefit from sustainability, it is critical to take into account the key role of innovation ambidexterity in firms' ability to achieve sustainability and whether the pursuit of sustainability helps firms in emerging countries to build strong brands and improve their long-term performance.

1.2 Research gaps and research questions

Reviewing the current literature on innovation and sustainability indicates that there are several major weaknesses in the theoretical and empirical developments within the current

debate around the role of innovation in sustainability, as well as factors that support innovation and the value of pursuing sustainability to brand success.

First, research and anecdotal evidence suggests that sustainability may have a path dependency on a firm's ability to maximize innovation outcomes (see Boons et al., 2013; Klewitz & Hansen, 2014; Van Bommel, 2011). While innovation plays a role in the firm's ability to contribute to sustainability, just how specific forms of innovation grounded in radical and incremental innovation are best managed to improve sustainability is at present unclear. The pursuit of radical and incremental innovation holds different implications for a firm's ability to achieve desired outcomes, especially in how it manages its sustainability activities (Boons et al., 2013; Klewitz & Hansen, 2014). For example, incremental innovation may slow down the firm's pace of change and the effective development of sustainability practices (Epicoco, 2016; Markard, Raven, & Truffer, 2012). Yet, incremental innovation is associated with less risk and more thoughtful consumption of organizational resources (Fernhaber & Patel, 2012). In contrast, radical innovation helps the firm conquer organizational rules and well-established cultures and take the firm out of the trap of innovation inertia (Ceschin, 2013). However, it may increase uncertainty in consumption of valuable resources in emerging countries (Epicoco, 2016). Thus, if a firm uses both radical and incremental innovation simultaneously, it is possible that together they compensate for the inherent negative effects of each on sustainability. Despite this possibility, there is a lack of conceptual and empirical clarity pertaining to unpacking the mechanisms by which radical and incremental innovation when managed ambidextrously drive sustainability of firms operating in emerging countries. This is in line with calls for further research on the application of ambidexterity to the sustainability domain (see Maletič, Maletič, Dahlgaard, Dahlgaard-Park, & Gomišček, 2014).

In addition, while innovation may unlock sustainability it does not occur in a vacuum and firms must be guided by astute management to maximize innovation and sustainability.

Prior research has suggested that leadership styles dominant in the firm, as well as behavioral aspects associated with managers' attitudes regarding environmental and sustainability issues are critical in environmental strategic decisions (e.g., Jones, Michelfelder, & Nair, 2017; Papagiannakis & Lioukas, 2012). However, little emphasis has been placed to unpack the role that managerial behaviors such as CEOs' leadership style and managers' attitudes play in supporting sustainability through organizational innovation. Based on the above argument, a fundamental question can be raised:

> *Research Question 1: (a) To what extent does innovation ambidexterity drive sustainability? And (b) To what extent do CEOs' leadership style and business unit managers' attitudes toward sustainability elevate the impact of innovation ambidexterity on sustainability?*

Second, prior research in the context of business-to-customer (B2C) implies that the adoption of sustainability practices such as prevention of pollution and reduced consumption of natural resources influence customers' perceptions of brands, change their preferences when making purchases, and drive the overall long-term health of the business (Chen, 2010; Olsen, Slotegraaf, & Chandukala, 2014). However, despite the increasing popularity of sustainability among B2B firms, this has not corresponded with an increased understanding of its actual effects for driving brand image as a major determinant of business success, especially in emerging countries (Nyadzayo, Matanda, & Rajaguru, 2018; Reijonen, Hirvonen, Nagy, Laukkanen, & Gabrielsson, 2015; Simões, Singh, & Perin, 2015). The paucity of empirical research regarding the branding consequences of sustainability in the B2B context compared to B2C is surprising given that the predominant marketing activities occur in the B2B environment and organizational buying of industrial products exceeds purchases by end-consumers (Mariadoss et al., 2011; Sheth & Sinha, 2015). Furthermore, branding in B2B firms

is more complex owing to extended networks of multiple stakeholders (Sheth & Sinha, 2015). These issues highlight the need for greater attention to B2B research at the intersection of sustainability and branding.

In addition, the literature on sustainability has shown that close relationships with customers enable firms to improve their competitive position derived from adopting sustainability practices (e.g., de Sousa Jabbour, Vazquez-Brust, Jabbour, & Latan, 2017; Junquera, del Brío, & Fernández, 2012). Further, more broadly prior research has indicated that customers with more favorable attitudes toward sustainability exhibit more congruence with a firm that pursues sustainability practices (Jaiswal & Kant, 2018; Kang, Stein, Heo, & Lee, 2012). However, B2B marketing research has not included customer relationship management (CRM) and customers' attitude toward sustainability for firms following sustainability practices to develop their brands. Based on the above argument, a fundamental question can be raised:

Research Question 2: (a) To what extent does the pursuit of sustainability improve a B2B firm's brand image? (b) To what extent does customer relationship management help B2B firms elevate the impact of sustainability practices on building strong brand image? And (c) To what extent do customers with positive attitudes toward sustainability help B2B firms enhance the effect of sustainability practices on building strong brand image?

Third, research question one highlights the importance of ambidextrously management of different forms of innovation (i.e., radical and incremental innovation) to drive sustainability. Prior literature has suggested that a key activity being pursued to enhance innovation is integrating supply chain partners (Lau, Tang, & Yam, 2010; Ralston, Blackhurst, Cantor, & Crum, 2015). Supply chain integration, both externally (across suppliers and customers) and internally (across departments and functions), enables firms to access and

leverage resources internally and across the supply chain, which is imperative to innovation (He, Lai, Sun, & Chen, 2014; Narasimhan & Narayanan, 2013; Wong, Wong, & Boon-itt, 2013). Despite the majority of studies argue for the critical impact of supply chain integration on innovation, no research has investigated the extent that supply chain integration improves radical and incremental innovation. Further, current literature has combined the effect of both supplier integration (SI) and customer integration (CI) into a single construct (see Schoenherr & Swink, 2012; Wong et al., 2013). This unified view toward external integration limits our understanding of the extent that suppliers and customers individually contribute to innovation outcomes. This is also in line with calls by Wong et al. (2013) and Zhao, Huo, Selen, and Yeung (2011) who have called for further research on the individual effects of SI and CI on innovation. Furthermore, prior research has not examined the way SI and CI work together to achieve radical and incremental innovation and whether the simultaneous integration of both can determine a positive additional synergistic effect on firms' innovation performance.

In addition, prior studies such as Zhao et al. (2011) and Zhao, Feng, and Wang (2015) have highlighted the importance of internal integration as a crucial building block for maximizing the benefits of supply chain integration for innovation performance. However, there is limited empirical evidence addressing the contingency effect of internal integration on the relationship between external integration and the degree of innovation. Based on the above argument, a fundamental question can be raised:

> *Research Question 3: (a) To what extent do supplier integration and customer integration individually enhance radical and incremental innovation? (b) To what extent does the combined effect of supplier and customer integration enhance radical and incremental innovation? And (c) To what extent does internal integration foster the relationship between external integration and radical and incremental innovation?*

1.3 Research contributions

In addressing the identified gaps and research questions in Section 1.2, this research makes the following contributions to the literature and theory related to emerging countries in the areas of sustainability, innovation, branding, and supply chain.

First, in addressing Research Question 1, this research contributes to the literature by examining the extent that innovation ambidexterity enhances sustainability of manufacturing firms operating in emerging countries. While the current literature has mainly focused on financial performance being beneficial outcomes of ambidexterity (e.g., Lin et al., 2013; Tan & Liu, 2014; Zhang, Edgar, Geare, & O'Kane, 2016), this study advances the understanding about the extent that other forms of performance such as sustainability is relevant to innovation ambidexterity. Furthermore, researchers have stressed the importance of radical innovation over incremental innovation to foster sustainability (e.g., Klewitz & Hansen, 2014). In contributing to the existing literature, this study unpacks the mechanisms by which radical and incremental innovation, when managed ambidextrously drive business sustainability. Understanding if business sustainability can be enhanced through innovation ambidexterity is imperative considering the seriousness of sustainability issues and society's growing focus on protecting the environment, especially in emerging countries. In addition to focusing on innovation and sustainability, the study brings critical attention to the contingent roles of CEOs' leadership style and business unit managers' attitudes toward sustainability in the innovation-sustainability relationship. In doing so, the study advances understanding about the conditions under which innovation ambidexterity leads to a greater sustainability.

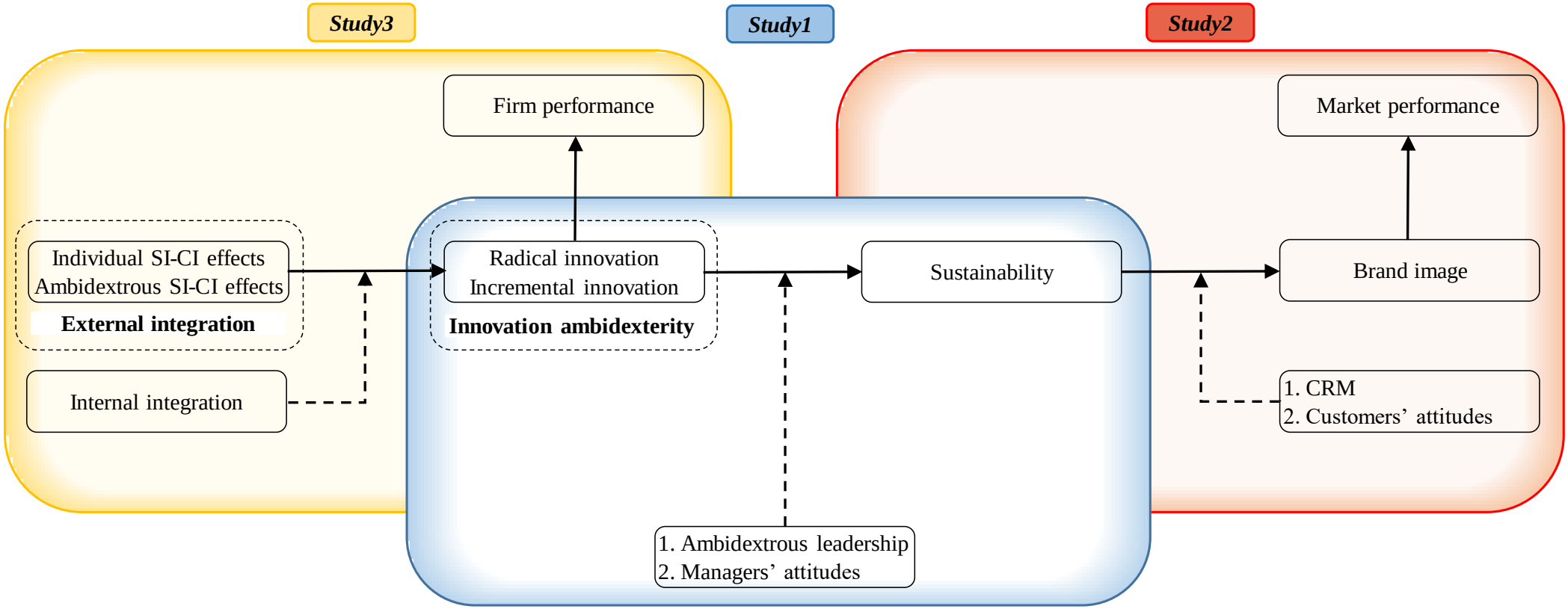
Second, in addressing Research Question 2, this research contributes to the literature by examining the extent that sustainability practices improve brand image in B2B firms operating in emerging countries. This is important because many B2B firms are increasingly blamed and face loss of legitimacy and trust because they are considered to be thriving at the expense of societies where they conduct their businesses (cf., Sheth & Sinha, 2015). This is mainly

because B2B firms' operations rely heavily on large-scale resources and have detrimental effects on the natural environment (Sheth & Sinha, 2015). Understanding the extent that sustainability contributes to brand image may better direct a firm's attention to its sustainability activities in strengthening brand image and improving long-term performance. In doing so, the study also addresses the call for research by Kumar and Christodoulopoulou (2014) and Sheth and Sinha (2015) to explore the significance of sustainability in B2B branding. Furthermore, by investigating the potential influence of CRM and customers' attitudes toward sustainability, the study provides an insightful picture of determinant role of supply chain partners' views and relationships with them in maximizing the consequences of investments in sustainability with respect to brand success.

Third, in addressing Research Question 3, this research contributes to the literature by examining the extent that individual and combined effects of SI and CI enhance radical and incremental innovation. In doing so, the study advances understanding about firstly, whether the integration of upstream suppliers and/or downstream customers are likely to impact on innovation, and secondly which form of SI and CI (complementary or balanced) is more or less beneficial to maximize innovation. This contribution is important, because it provides a better understanding of how to manage available resources and capacity to integrate suppliers and customers to achieve superior innovation outcomes. Furthermore, the study provides a better understanding of the pivotal role of internal integration, in seeking to facilitate the effect of external integration on the degree of innovation in the form of radical and incremental innovation.

Taking on board the research questions and contributions, this thesis develops three inter-related but distinct papers. The theoretical framework of this research encapsulating the overall study is "Sustainability in the B2B manufacturing sector: drivers and outcomes" and is presented below in Figure 1.1.

Figure 1.1 Sustainability in the B2B manufacturing sector: drivers and outcomes



1.4 The context

Unlike developed countries that for some time have engaged in a debate over sustainability in manufacturing operations, emerging countries have become part of the sustainability debate much later (Geng, Mansouri, Aktas, & Yen, 2017). As such, for many firms operating in emerging countries implementing sustainability practices has been more challenging due to a lack of institutions and regulatory frameworks, poor oversight, and outdated production systems (Geng et al., 2017; Sheth & Sinha, 2015). This challenge (problem) is compounded in emerging countries by a slower pace of technology deployment and use of non-frontier technology (Tan, 2010). Adding to the challenge in emerging countries, the lower labor and raw material costs, as well as flourishing markets for selling products have caused emerging countries to experience a rapid economic development and growing manufacturing sector (Geng et al., 2017; Rauch, Dallasega, & Matt, 2016). With growing production capacities in emerging countries, they are now placed at the forefront of sustainability issues because of natural resource exploitation and environmental degradation (Geng et al., 2017; Lai, Wong, & Lun, 2014). Nonetheless, growing numbers of manufacturing firms in emerging countries are developing sustainability strategies in concert with their home governments enacting tighter environmental laws and policies to ensure that manufacturers have requirements for the environment built into their operations (Esfahbodi et al., 2016).

Emerging countries are classified into various categories such as BRICS (Brazil, Russia, India, China, and South Africa), MENA (Middle East and North Africa), RDE (Rapidly Developing Economies), and Next-Eleven with each category possessing some unique features (Rauch et al., 2016). This study focuses on Iran as one of the Next-Eleven emerging countries (Heirati & O'Cass, 2016; Wilson & Stupnytska, 2007). Growing pollution and natural resource depletion are significant in this country context. Particularly, the heavy dependence of the Iranian manufacturing sector on fossil fuels has made the country one of 20 countries

responsible for an estimated 75% of global greenhouse gases (Kakaee & Paykani, 2013; Nasiri, Khorshid-Doust, & Moghaddam, 2013). Iran as one of the Next-Eleven emerging countries has a high potential of moving into the world's top-20 economies by 2025 (Martin, 2012). Emerging countries such as the Next-Eleven may act as a bridge between developed countries and developing (and underdeveloped) countries (Kvint, 2009) in demonstrating economic development and what happens along the way. In effect, what happens in the Next-Eleven countries may provide a road map on how to achieve sustainability to those countries coming behind the Next-Eleven counties. Such a road map may help manufacturing firms in emerging countries to more effectively pursue sustainability on a global scale. Such a road map is important because sustainability provides benefit to a wider stakeholder group, as well as back to the firms, which may actually induce greater efforts in terms of sustainability.

1.5 Research method

As mentioned above, in order to address Research Questions 1, 2, and 3, this thesis comprises three inter-connected papers. Data were collected for the studies over a period of eight months. The data collection occurs in two phases. In the first phase, two surveys are developed and administrated to multiple production managers and multiple supply chain managers of manufacturing firms (labeled as survey A for production managers and B for supply chain managers). In the second phase, another two surveys are developed and administrated to multiple key suppliers who sell to each of the surveyed firms, and multiple key customers who purchase from each of the surveyed firms (labeled as survey C for suppliers and D for customers). Overall, from a sample of 140 firms, 1540 usable surveys were received, which included 370 production managers, 346 supply chain managers, 536 tier-one suppliers, and 288 tier-one business customers. Coded surveys are used to match (link) completed responses for the firms, their suppliers, and their customers. Using a multi-stakeholder design

and matched data not only minimizes concerns over single source bias, but also enhances the robustness of the findings and strengthens our theory testing (Liao & Subramony, 2008).

The surveys are designed by using well-established measures from the existing literature, and, where required, some modifications are conducted to fit the context of the research. In developing all four surveys, the double translation method is followed. The original surveys are developed in English, and then translated into Persian and back-translated into English to ensure the accuracy of translation (see Zhao et al., 2011). Following this process, the surveys are pretested using a sample of managers to ensure the readability, flow and conceptual clarity of the surveys. To establish psychometric properties and test the hypotheses, a range of data analysis techniques such as descriptive statistics, reliability, convergent validity, discriminant validity, and hierarchical regression analysis method are conducted.

1.6 A summary of papers

Paper 1: Improving manufacturers' business sustainability through innovation ambidexterity, CEOs' leadership style, and business unit managers' attitudes (Under review at Journal of Product Innovation Management, ranked A* in ABDC list)

Although many researchers (e.g., Lin et al., 2013; Tan & Liu, 2014; Zhang et al., 2016) have suggested that innovation ambidexterity is a critical input to increase performance across a wide range of areas, limited attention has been given to unpacking the mechanisms by which innovation ambidexterity enhances sustainability. In seeking to provide evidence of the interplay between innovation and sustainability this paper relies on organizational ambidexterity theory to articulate an underlying mechanism that demonstrates the extent that innovation ambidexterity enhances sustainability of manufacturing firms operating in emerging countries. In addition, this paper focuses on the role of CEOs' ambidextrous leadership and business unit managers' attitudes toward sustainability as moderating factors

that affect the relationship between innovation and sustainability. To test the theory, this paper draws on a sample of production managers and supply chain managers from manufacturing firms in an emerging country. The results show sustainability is driven by innovation ambidexterity and this relationship is significantly improved by CEOs who engage in ambidextrous leadership and business unit managers who hold favorable attitudes toward sustainability. The results contribute to theory and practice by providing a deeper understanding of the key drivers of sustainability. The complete paper is presented in Chapter 2.

Paper 2: Driving business to business brands: Signal your sustainability and manage your customer relationships and attitudes (Under review at Journal of the Academy of Marketing Science, ranked A* in ABDC list)

Recent literature has highlighted that there is a growing awareness among business customers in regarding the environment and the necessity of adoption of sustainability practices (e.g., Kumar & Christodoulopoulou, 2014; Sharma et al., 2010). Yet, B2B manufacturing firms in emerging countries continue to lack a clear understanding of the implications of investments in sustainability in terms of improving customer-related outcomes, especially their brands as a major marketing asset. Building on signaling theory this paper focuses on the conditions in which sustainability practices in B2B manufacturing firms operating in emerging countries improve their brand image, which can in turn, result in improvements in market performance. To unpack the relationship, this paper introduces contingency elements by examining the roles CRM and customers' attitudes toward sustainability in moderating the effect of sustainability on brand image. Drawing on a multi-informant dataset collected from B2B manufacturing firms and their customers, the paper shows that sustainability practices significantly drive brand image and this relationship is contingent on CRM and customers' attitudes toward

sustainability. The results also show that manufacturing firms with an increased brand image have higher levels of market performance. The results of this study provide new insights into how firms can build a strong brand using sustainability. The complete paper is presented in Chapter 3.

Paper 3: Does the ambidextrous integration of suppliers and customers contribute to radical and incremental innovation? (Under review at Journal of Operations Management, ranked A* in ABDC list)

A great deal of research on innovation relies upon supply chain integration to explain a firm's innovation capabilities. However, uncertainty still exists about the extent to which SI and CI benefit a firm's level of radical and incremental innovation. This paper adopts the relational view theory to explain the individual effects of SI and CI to improve a firm's radical and/or incremental innovation and its performance outcomes. Further, relying on ambidexterity theory, this paper applies the concepts of balanced integration and complementary integration to explain how the combined effects of SI and CI generate radical and incremental innovation and thereby, impact firm performance. In addition, the paper addresses the moderating role of internal integration as key to fostering the relationship between external (supplier and customer) partner integration and radical and incremental innovation. To test the theory, the paper uses a multi-stakeholder design and matched data from manufacturing firms and their upstream suppliers and downstream customers. The findings indicate that SI helps firms generate more radical than incremental innovation, while CI helps generate more incremental than radical innovation. The results also show that complementary integration is positively related to radical and incremental innovation, while balanced integration is unable to improve innovation. Moreover, the findings highlight the important role of internal integration in improving the effects of external integration on radical and incremental innovation. Finally,

the findings show that both radical and incremental innovation are differentially beneficial to drive firm performance. This paper provides new insights into the forms of integration that increase radical and incremental innovation. The complete paper is presented in Chapter 4.

1.7 Definitions of key constructs

Table 1.1 provides the definitions of key constructs used in the theoretical framework outlined in Figure 1.1. This is important given that there is an abundance of diverse definitions for the key constructs of the study in the literature.

Table 1.1 Construct definitions

Construct	Definition
Sustainability	Organizational activity that is directed to reducing pollution and efficient use of energy and other resources aiming at diminishing the detrimental effects of firms' activities on the environment and human race (Gupta & Kumar, 2013).
Radical innovation	Involves fundamental changes in procedures leading to a switch from existing processes and products to those that are new to a firm or industry (Fernhaber & Patel, 2012).
Incremental innovation	Refines and improves established procedures and represents relatively minor adaptations of existing products and processes (Fernhaber & Patel, 2012).
Innovation ambidexterity	The simultaneous achievement of radical and incremental innovation (Lin et al., 2013).
Ambidextrous leadership	The ability of deploying both transformational and transactional leadership styles (Luo, Zheng, Ji, & Liang, 2016).
Manager (customer) attitudes toward sustainability	The degree to which a manager (customer) has a favorable or unfavorable evaluation or appraisal of sustainability (adapted from Ajzen, 1991).
Brand image	A set of information connected to a brand in the minds of customers (Keller, 1993).
CRM	A firm's ability to identify attractive customers and prospects, initiate and maintain relationships with attractive customers, and

Table 1.1 Construct definitions

Construct	Definition
	leverage these relationships into customer level profits (Morgan, Slotegraaf, & Vorhies, 2009).
Supplier (customer) integration	The degree to which a firm collaborates with its key suppliers (customers) to structure inter-organizational strategies, practices, procedures, and behaviors into collaborative, synchronized, and manageable processes to fulfill customer requirements (Zhao et al., 2015).
Internal integration	The extent to which communication, coordination, and teamwork exists across functions within a firm (Dobrzykowski, McFadden, & Vonderembse, 2016).

1.8 Outline of the thesis

The thesis incorporates five chapters. Chapter 1 presents the background of the study followed by the research gaps and research questions. Then, contributions and the context of this study are provided. Further, an overview of the methodological and analytical approaches adopted to conduct the research are specified. In addition, a summary of the three papers is outlined, key constructs are defined, and the structure of the study is introduced. Finally, a conclusion is presented.

Chapter 2 presents paper 1 which examines the relationship between innovation ambidexterity and sustainability and how this relationship varies at different forms of CEOs' leadership and business unit managers' attitudes toward sustainability. Chapter 3 presents paper 2 which explores the interplay between sustainability practices and brand image and provides clarification on the role of CRM and customers' attitudes toward sustainability in enhancing this relationship. Chapter 4 presents paper 3 which investigates the significance of internal and external integration in developing radical and incremental innovation, which can in turn, lead to a superior performance. Chapter 5 synthesizes the findings of each of the papers to present them in the context of the overall research program and provides implications for

theory and practice. The study finishes with a discussion about the limitations of the research and suggestions for future research in the domain.

1.9 Conclusion

The path dependency of growth in firms through greater consumption of resources is continuing to trend upward and raising many challenges related to sustainability of the global community. The cost of resource exploitation and the resulting environmental damage is even more observable for manufacturing firms operating in the B2B environment whose operations are resource intensive and who are identified as a significant source of environmental degradation. Reviewing the research on sustainability indicates that whereas most studies have focused on the necessary conditions for transition toward sustainability, research has rarely investigated how firms operating in B2B emerging countries may achieve sustainability and whether the pursuit of sustainability underpins marketing assets. With the growing trends in sustainability in emerging countries, it is important to understand how B2B manufacturers in this context are working to achieve this objective and can be better support to maximize sustainability efforts. The purpose of this research is identifying key antecedents and consequences of sustainability in B2B manufacturing firms.

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Chapter 2

Improving manufacturers' business sustainability through innovation ambidexterity, CEOs' leadership style, and business unit managers' attitudes

Under review at Journal of Product Innovation Management, ranked A* in ABDC list

Abstract

The continued growth of industry in emerging countries has raised concerns about environmental degradation and intensive resources consumption, and is generating major challenges related to business sustainability. While there are firms who offer bleak forecasts because of increasing raw material and energy costs, growing concerns about resource depletion, pollution, and pressures from climate change, it is pleasing to see business sustainability has risen to be a key objective of forward-looking firms operating in emerging countries. For these firms, the only way to catch up or keep pace with new operation trends suggested in the literature to support business sustainability is innovation and more importantly it is through the appropriate management of innovation activities. However, we[3] lack understanding about how specific forms of innovation are best managed to support business sustainability. Drawing on multi-informant data from an emerging country, we show the simultaneous management of radical and incremental innovation (hereafter innovation ambidexterity) contributes to business sustainability. Furthermore, our results indicate that the relationship between innovation ambidexterity and business sustainability varies at different levels and forms of CEOs' leadership (i.e., ambidextrous leadership) and business unit managers' attitudes toward sustainability.

Keywords: business sustainability, innovation ambidexterity, ambidextrous leadership and managers' attitudes.

[3] The use of the pronoun 'we' in the thesis is to acknowledge the contribution of the supervisory team and is used in the papers submitted to journals for review.

2.1 Introduction

Emerging countries are experiencing rapid development, the pace of which for some is even faster than many developed countries (Rauch et al., 2016)[4]. This trend has been driven mainly by two factors. Firstly, growing urban populations in emerging countries are paving the way for growth in sales of products and services (Rauch et al., 2016). Secondly, lower labor and raw material cost in emerging countries have seen these countries' manufacturing sectors prosper (Geng et al., 2017). However, as noted by Esfahbodi et al. (2016) the rapid economic growth in emerging countries which corresponds with the growth in their manufacturing sectors is driving intensive use of energy and other resources. As a result, more environmental problems are being created (e.g., oil consumption) which are a growing concern to the public and governments. From 1980 to 2013, the world's oil consumption increased by 50%, yet in those countries that are classified as the Next-Eleven[5] emerging countries, this increase has been over 200%, along with a doubling in their gas emissions of which a large portion relates to industrial emission (Nasre Esfahani & Rasoulinezhad, 2015).

To provide solutions to unstainable growth and controls for pollution and resource depletion, many academics and practitioners have contributed to the growing debate around business sustainability (Boons et al., 2013; Silvestre, 2015). Business sustainability[6] is defined as an organizational activity that is directed to reducing pollution and efficient use of energy and other resources aiming at diminishing the detrimental effects of firms' activities on the environment and human race (Gupta & Kumar, 2013).

[4] In-text citations and reference lists are presented in the same way as required in the journals in which the papers have been submitted for review.

[5] Emerging countries are classified into various categories such as BRICS, MENA, and Next-Eleven with each category possessing some unique features (Rauch et al., 2016). This research specifically focuses on the common themes that appear in Next-Eleven countries around issues of growing pollution, natural resource depletion, and sustained economic growth and development which are significant in this context.

[6] The term 'business sustainability' has often been used in the literature to refer to the long-term survival of a business and address issues such as sales, market share, profitability, and competitive advantage (see Olson et al., 2005; Porter, 1991, Gupta et al., 2011). However, in the current study business sustainability is related to prevention of pollution, minimization of waste, and reduction of energy or raw material consumption.

Current literature supports the view that innovation is the solution to overcome problems associated with business sustainability (Boons et al., 2013; Klewitz & Hansen, 2014; Silvestre, 2015). Innovation may foster methods that enable firms to engage in more efficient consumption of resources and reduce damage to the environment through new or improved operations, and environmental friendly products. While current literature has identified different categories of innovation, one of the most widely adopted approaches toward categorizing innovation is radical and incremental innovation (e.g., Lin et al., 2013; Fernhaber & Patel, 2012). The current literature on innovation has documented that either of these approaches have advantages and disadvantages (Jansen et al., 2006). The inherent advantages and disadvantages of innovation have led researchers to believe if firms pursue both of these approaches simultaneously, will achieve greater success (Lin et al., 2013; Zhang et al., 2016). The simultaneous pursuit of both radical and incremental innovation has been framed in the notion of innovation ambidexterity (Chang & Hughes, 2012; Tan & Liu, 2014). While the performance effects of managing trade-offs across a wide range of issues and areas are acknowledged as positive, the performance effects of innovation ambidexterity on business sustainability is unknown. This is particularly pertinent given the challenges that may arise from simultaneously pursuing radical and incremental innovation (Lin et al., 2013) and the growing challenges firms face to improve business sustainability (Epicoco, 2016).

While pursuing innovation to support sustainability may seem basic and straightforward, the challenges that firms face when undertaking innovation ambidexterity to support sustainability are complex and to a large extent may depend on the CEOs' leadership style. CEOs through their vision, attitudes, and leadership behaviors set the tone for the entire firm (Caridi-Zahavi et al., 2016). Emerging research on leadership notes that a leader can deploy both transformational and transactional behaviors (Luo et al., 2016). Yet, it is not clear whether ambidextrous leaders who are capable of deploying both transformational and transactional

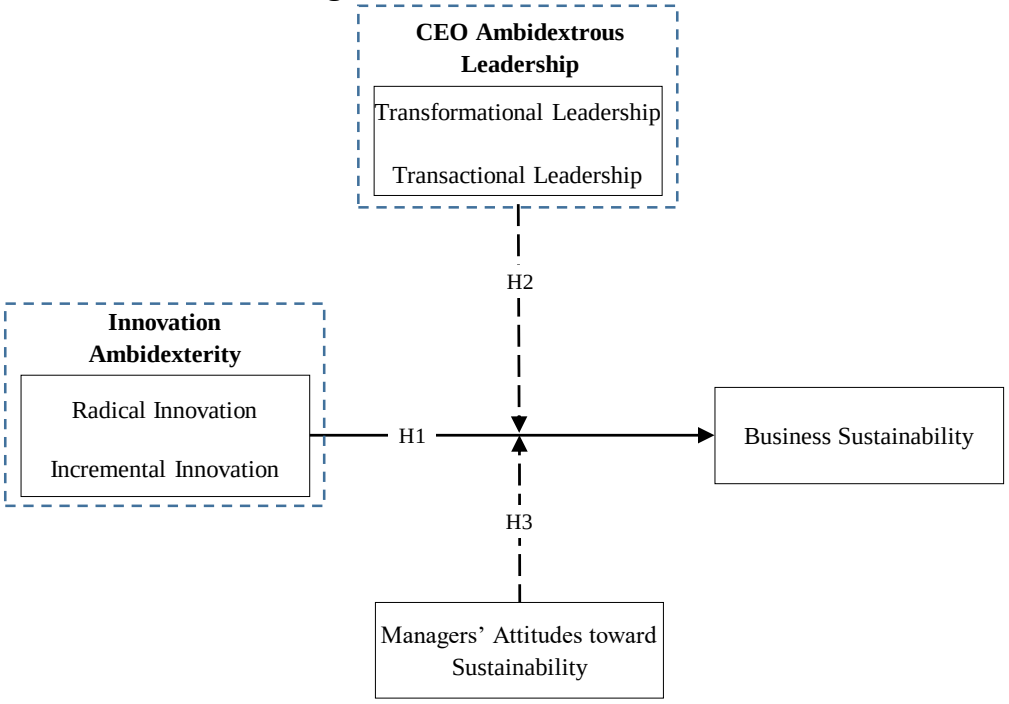
leadership styles enhance the impact of innovation ambidexterity on business sustainability. Furthermore, prior research shows that subordinates' interpretation of their leaders' motives and orientations, influences their behavioral responses (Bammens, 2016). Accordingly, at the business unit level, behavioral aspects associated with managers' attitudes regarding environmental and sustainability issues are critical in environmental strategic decisions (Papagiannakis & Lioukas, 2012). However, there has been a distinct lack of research investigating the contingency role of managers' attitudes in the context of innovation and business sustainability.

Given the shortcomings in the current literature on innovation and sustainability, this study seeks to answer two specific research questions. First, to what extent does innovation ambidexterity drive business sustainability? Second, to what extent do CEOs' leadership style and business unit managers' attitudes toward sustainability elevate the impact of innovation ambidexterity on business sustainability? With these two research questions, we provide three specific contributions to the literature. First, we use ambidexterity theory to unpack the connection between innovation ambidexterity and sustainability. The motivation for focusing on this theoretical framing is to respond to a call by Maletič et al. (2014) on the application of ambidexterity to the sustainability domain. We respond to their call by articulating the underlying mechanism that demonstrates the extent that innovation ambidexterity enhances business sustainability. Second, relying on leadership theory we respond to the call by Kortmann (2015) and investigate the contingency role of ambidextrous leadership on the relationship between firms' innovation ambidexterity and sustainability outcome. We contribute to this dialogue by articulating how and why the linkage between innovation ambidexterity and business sustainability accrues through CEO's ambidextrous leadership. Third, currently the sustainability literature neglects how different levels of managers' attitudes towards sustainability may change organizational processes and their outcomes (Papagiannakis

& Lioukas, 2012). Building on the work of Dibrell et al. (2011) and drawing on attitude theory, we explain the effect of innovation on sustainability and how this effect is strengthened when business unit managers possess positive attitude towards sustainability.

Our hypothesized model is shown in Figure 2.1. We test our theory drawing on a multi-informant dataset collected from production managers and logistics managers from different manufacturing industries operating in Iran, a Next-Eleven emerging country (Heirati & O'Cass, 2016; Wilson & Stupnytska, 2007) that has made significant progress in innovation across various industries (Scaringella & Burtschell, 2017). Studies that examine the influence of innovation on business sustainability among different industries are limited (Singh et al., 2014). Moreover, except for a few studies in China and Brazil (e.g., Silvestre, 2015; Zeng et al., 2011), most business sustainability research has been conducted in developed countries. The findings of the research using developed countries may provide some insights, but it cannot be extrapolated to emerging countries without caution. The findings of this study; therefore, not only contribute to sustainability theory, but also in practice give guidance to business in emerging countries about enhancing sustainable operations.

Figure 2.1 Research framework



2.2 Literature review

Ongoing concerns about resources, energy, and the environment are a top priority for the entire world (Epicoco, 2016; Yusuf et al., 2013). The cost of resource exploitation and environmental damage is now very observable in emerging countries as they rely heavily on fossil resources which increase their contribution to GHG emissions (Nasre Esfahani & Rasoulinezhad, 2015). The growing range of issues related to sustainability have given rise to a burgeoning body of research across a wide range of disciplines. For example, while some scholars focus on identifying the problems of depletion of energy reserves; others focus on how to reduce air pollution, both with the view to improve sustainability (Yusuf et al., 2013). For firms, commitment to business sustainability has been framed by referring to the concept of the triple bottom line (Elkington, 1998). The concept of triple bottom line indicates the main objectives for firms to achieve business sustainability are economic, environmental, and social sustainability (Gimenez et al., 2012). More recently, it has been shown that manufacturing firms often focus on or start with improvements in environmental and economic dimensions in their journey toward business sustainability (Du et al., 2013; Wagner, 2015). This is because the manufacturing sector often faces challenges in addressing efficiency of resource usage and controlling pollution, waste, and emissions (Gimenez et al., 2012; Yusuf et al., 2013). These challenges are gaining the attention of manufacturing firms because of their economic relevance (in terms of large resource and energy consumption) and their significant negative impact on the environment (pollution, toxic waste, and industrial accidents). Following previous research on business sustainability (e.g., Choi & Ng, 2011; Zhang et al., 2012), we focus on environmental and economic dimensions of business sustainability.

Environmental sustainability is related to reduction in air emissions, solid waste, waste water, consumption of hazardous/harmful/toxic materials, and environmental accidents (Gimenez et al., 2012; Zhu et al., 2010). Yusuf et al. (2013) describe environmental

sustainability as the protection of natural resources to preserve the environment for future generations. According to Bracho (2000), global warming and climate change have intensified the importance of environmental sustainability. Climate change is becoming so discernible that the United Nations passed the Paris agreement in 2015, insisting all countries, without exception, pursue efforts to limit temperature increases to below a 2°C target from pre-industrial levels by the rapid reduction in GHG emissions (Choi, 2018).

Economic sustainability, on the other hand, refers to the efficient utilization of energy and other resources to provide long-term operations and profitability, while minimizing the detrimental effects of resource exploitation (Sheth & Sinha, 2015). The main idea behind economic sustainability is that firms generate additional business opportunities if they enhance production efficiency, and decrease manufacturing costs (Yusuf et al., 2013). With growing concerns about energy efficiency, the challenge being faced by large energy-consuming firms is how to decrease the consumption of energy and other natural resources used in their processes (Ngai et al., 2013). If firms effectively and efficiently utilize natural resources, they will not only enhance their competitive advantage but also improve business sustainability (Tong et al., 2016).

An analysis of the literature on sustainability reveals two main streams of research have emerged. One stream of research on sustainability focuses on the impact of business sustainability to improve either firm-related outcomes such as profitability and market share (e.g., Gotschol et al., 2014; Jacobs et al., 2010) or customer-related outcomes such as customer loyalty and purchase intention (Choi & Ng., 2011; Chen, 2015). The other stream aims to identify the drivers of achieving business sustainability. This research stream mainly focuses on how firms can improve business sustainability through investments in organizational collaboration (e.g., Albino et al., 2012) or sustainable supply chain management (e.g., Zailani et al., 2012; Hsu et al., 2016). However, despite recent studies highlighting the implications of

innovation for business sustainability (e.g., Boons et al., 2013; Silvestre, 2015), few studies have explicitly examined its actual effects in addressing issues such as prevention of pollution, minimization of waste, and reduction of energy and raw material consumption.

Furthermore, to support business sustainability, not all firms engage in innovation with the same intensity. There are some firms that pursue more radical innovation, whereas others engage in more incremental innovation (Moyano-Fuentes et al., 2018). Radical innovation involves fundamental changes in procedures leading to a switch from existing processes and products to those that are new to a firm or industry (Fernhaber & Patel, 2012). Incremental innovation, in contrast, involves improving and refining established procedures and leads to relatively minor adaptations of existing processes and products (Fernhaber & Patel, 2012).

Even though previous research supports the positive impact of these innovation practices, they are also associated with some drawbacks. For example, incremental innovation may be slower in driving the firm forward and less effective in assisting the firm to catch up with the magnitude and pervasiveness of environmental impacts; and with greater waste of organizational and environmental resources in the long-term (Epicoco, 2016; Markard et al., 2012). Yet, for others incremental innovation is associated with less risk and more thoughtful consumption of organizational and natural resources in the short-term (Fernhaber & Patel, 2012). In contrast, radical innovation is thought to help the firm to conquer organizational rules, rigidities, and well-established cultures and take the firm out of the trap of innovation inertia and incrementally changing processes (Ceschin, 2013). In doing so, radical innovation is thought to enhance business sustainability by reducing environmental impact in terms of energy usage and increasing resource productivity because the firm engages in the development of totally new processes or products that can affect the environment less (Klewitz & Hansen, 2014). However, radical innovation may require large investments and greater use of

organizational resources and is a risky process due to the higher uncertainty surrounding the technological outputs (Epicoco, 2016).

However, while in isolation radical and incremental have positive and negatives; taken together, if a firm ambidextrously deploys both radical and incremental innovation simultaneously, it is possible that the positives of these innovation approaches can compensate for the inherent negatives of each and improve business sustainability. In the organizational learning literature, ambidexterity has traditionally been grounded in terms of a firm's ability to balance between the demands for exploitation and exploration (particularly exploitative learning and exploratory learning) (March, 1991; Tushman & O'Reilly, 1996). However, more recently researchers have used the notion of ambidexterity to refer to the firm's ability to pursue two conflicting tasks simultaneously, such as manufacturing efficiency and flexibility (Gibson & Birkinshaw, 2004), creativity and attention-to-detail (Sok & O'Cass, 2015; Sok et al., 2018), responsive and proactive market orientations (Tan & Liu, 2014), service and sales (Yu et al., 2013), and R&D and marketing (O'Cass et al., 2014). More specifically, within the technological innovation context, Lin et al. (2013) define innovation ambidexterity as the simultaneous achievement of radical and incremental innovation.

In analyzing the ambidexterity literature, there are different approaches to pursuing competing activities: contextual, structural, and realized. We focus here on contextual ambidexterity, which emphasizes managing the balance between potentially opposing attributes – radical and incremental innovation – within one business unit to maximize their complementarity (Gibson & Birkinshaw, 2004). There are two types of contextual ambidexterity – balanced and combined ambidexterity. They have significant differences regarding the incompatible or complementarity logic of deploying radical and incremental innovation (Chang & Hughes, 2012).

Some researchers argue a firm should dynamically and appropriately balance the relative level of radical and incremental innovation (Zhang et al., 2016). Alternatively, others suggest a firm should perform high levels (as high as possible) of both radical and incremental innovation to leverage the complementary effects from these two types of innovation (Lin et al., 2013). Those espousing an incompatible logic, often adopt the view that a firm allocates resources equally to radical and incremental innovation (Tan & Liu, 2014; Zhang et al., 2016). By placing equal emphasis on radical and incremental innovation a firm may find it difficult to maximize the benefits from either radical or incremental innovation. It seeks to devote equal resources to both radical and incremental innovation and does not make any trade-offs between them. Thus, it may fail to achieve superior benefits from either radical or incremental innovation. While this view has merit, we adopt Lin et al.'s (2013) view of innovation ambidexterity, where innovation ambidexterity focuses on pursuing high levels of both types of innovation simultaneously which captures the notion of the combined view of ambidexterity.

2.3 Hypotheses

2.3.1 Innovation ambidexterity and business sustainability

Prior research suggests that a firm which is able to achieve both radical and incremental innovation at the same time is likely to provide additional benefits beyond those provided by focusing on either radical or incremental innovation at the expense (exclusion) of the other (Lin et al., 2013; Tan & Liu, 2014). Incremental innovation encompasses slight (minor) improvements in processes and products and is effective to improve product flexibility and reduction of production costs (Raisch & Birkinshaw, 2008; Fernhaber & Patel, 2012). Through incremental innovation a firm can improve deficiencies in existing processes and products and these slight changes may lead to reductions in energy and material consumption or emissions

in production processes. Consequently, the firm may improve the eco-efficiency of processes and refine its products to be more environmentally friendly (Boons et al., 2013; Du et al., 2013).

However, firms that engage too heavily in incremental innovation may suffer from obsolescence and inertia due to a lack of technological progress (Lin et al., 2013; Rothaermel & Alexandre, 2009). These firms are likely to achieve only minor changes and may not fully capture the benefits associated with generating new routines (e.g., prototyping, production technologies, and facilities). Therefore, due to the pervasiveness of sustainability-related challenges facing manufacturing firms, it is unlikely that incremental innovation in existing processes and products alone will address these challenges (Markard et al., 2012).

Radical innovation, on the other hand, overcomes innovation inertia by generating completely new processes and products with distinctive and unique utilities not obtainable from existing or refined processes and products (Lin et al., 2013). New processes offer the ability to implement beneficial new technologies and adopt new product development skills. Further, radical innovation allows production of innovative and unique product features that may enhance resource efficiency and reduce environmental impact regarding product consumption (Du et al., 2013; Klewitz & Hansen, 2014; Maletič et al., 2014). Therefore, pursuing radical innovation may enable firms to develop products and production processes that reduce consumption of resources, control pollution, waste, and emissions which improve business sustainability.

However, radical innovation is also associated with high risk of failure in developing new products and processes (Lin et al., 2013). Further, because of the level of newness of radical innovation, it takes more time to adjust technologies, procedures, and practices within the firm to address sustainability challenges. Additionally, a firm that engages too heavily in radical innovation, may develop uniquely distinct and novel procedures (e.g., technologies,

processes, and systems) without acquiring or extending the competencies required to identify and exploit the available opportunities (Rothaermel & Alexandre, 2009).

In identifying the individual strengths and weakness of each form of innovation in isolation, these different forms when used together may offer unique solutions to improve business sustainability. The combination of radical and incremental innovation may provide a significant advantage for a firm to enhance its business sustainability. According to Kennedy et al. (2017), there is a greater probability of producing a final product with a significant best-in-class environmental footprint from radical innovation. As such, radical innovation is more likely to provide a major breakthrough in sustainability resulting from its effectiveness in establishing far-reaching changes in products and production processes. In support, incremental innovation is more likely to create a relative improvement in environmental and/or economic performance of production processes compared to the current situation and ensure low-cost production process with a better environmental footprint. The benefits obtained from undertaking both types of innovation and the disadvantages attributed to one type can be offset by the advantages of the other and vice versa. Thus, we argue that by being ambidextrous and engaging in high levels of both radical and incremental innovation, a firm is more likely to foster business sustainability at a greater level than if only one form of innovation is pursued, suggesting that,

H1: Innovation ambidexterity is positively related to business sustainability.

2.3.2 Moderating effect of CEOs' ambidextrous leadership

The impact of innovation on sustainability activities can vary as leaders engage in different types of leadership style. The clarity of guidelines and signals sent to subordinates that promote sustainability may engage subordinates in developing ideas about new products and processes that are more environmental friendly (Jones et al., 2017; Tomšič et al., 2015).

This may occur when leaders clearly define sustainability values and consistently communicate and reinforce such values throughout the firm (Tomšič et al., 2015; Stoughton & Ludema, 2012).

In studying leadership, we focus on two well-recognized leadership styles, transformational leadership and transactional leadership. Transformational leaders are able to develop a vision for their firms and stimulate subordinates' (i.e., business unit managers) intelligence and creativity (Deichmann & Stam, 2015). Leaders who deploy a transformational style support, motivate, and inspire subordinates to transcend their own personal interests and engage in activities that go beyond the expectations to achieve the overall goals of the firm (Chang et al., 2015). In contrast, transactional leadership is manifested as a cost/benefit trade-off process because leader-follower relationships are underpinned by series of exchanges and rewards (Chang et al., 2015). Transactional leaders clarify expectations and motivate subordinates' compliance behavior to achieve expected performance goals by providing external rewards (Bass, 1985).

It has been noted that a leader can display both transformational and transactional behaviors with varying levels of intensity (e.g., Birasnav, 2014; Luo et al., 2016). For example, Rosing et al. (2011) argue that a single leadership style is less capable of effective innovation. Instead, a combination of different leadership behaviors implemented to manage changing requirements may be more effective. Building on the same view, Luo et al. (2016) suggest that an effective leader is able to determine the applicability of their leadership style or behaviors to different situations, and for example, exhibit transformational and transactional leadership behaviors accordingly. This view of leadership has resulted in an emerging concept of ambidextrous leadership.

Ambidextrous leaders are those who are capable of deploying both transformational and transactional leadership styles (Luo et al., 2016). Given the rapid pace of economic

development in emerging countries, firms will need subordinates to undertake divergent tasks and multiple activities by motivating them to take risks and encouraging alternative methods for task accomplishment. In such a situation, organizational learning is needed to guarantee adaptive and progressive firm behavior, leaders must engage in transformational behaviors (Luo et al., 2016). Furthermore, given the constant and ongoing changes acknowledged in emerging countries, leaders must ensure that rules are followed, goals are achieved, and corrective actions are taken when necessary. This implies transactional leadership must be undertaken. As such, given the predicaments leaders face in a changing environment like being experienced in emerging countries, a single leadership style may not be suitable and leaders need to have the capacity to deploy both leadership styles. In such a situation, leaders should adopt the most appropriate approach for any situation, which requires ambidextrous leadership (Luo et al., 2016; Rosing et al., 2011).

Building on the work of Rosing et al. (2011) we argue that CEOs can enhance the effect of innovation ambidexterity on business sustainability by displaying behavioral repertoires that foster passion, risk-taking, and creativity (i.e., transformational leadership) as well as consistency, stability, and control (i.e., transactional leadership). CEOs engaging in ambidextrous leadership not only encourage subordinates' creativity to challenge assumptions and take risks, but they also foster subordinates' extrinsic motivation, leading them to develop their creativity through rewards and punishment system.

Ambidextrous transformational and transactional leaders provide a clearer direction and vision as well as to set boundaries and motivations in terms of rewards and punishments. When leaders are not capable of deploying both leadership styles they are less to clarify necessary sustainability-related expectations, nor will they provide a concrete direction for subordinates to include sustainability initiatives as part of the subordinates' routine practices. In contrast, given stakeholders' mounting pressure on firms for being committed to sustainability, many

CEOs because of their position and what is expected of them may prioritize sustainability as a key objective. In such a situation, CEOs who engage in ambidextrous leadership behavior are more likely to envision business sustainability as a vital strategy for their firms and at the same time closely monitor subordinates' performance to ensure the achievement of sustainability-related goals. In doing so, these leaders may establish an innovation-supportive culture to increase subordinates' intrinsic motivation and encourage them to adopt critical thinking that may facilitate the ability to use creative ideas. At the same time, they convey the advantages of incremental refinements to existing innovation trajectories that would enable subordinates to improve business sustainability that stems from incremental innovation.

CEOs who deploy both transformational and transactional type behavior may broaden the awareness of opportunities and ideas presented by radical and incremental innovation and create an increased opportunity for tackling sustainability-related challenges. Drawing on these contentions, we argue that ambidextrous leaders enhance the effect of the simultaneous pursuit of radical and incremental innovation (innovation ambidexterity) on business sustainability, suggesting that,

> *H2: Ambidextrous leadership positively moderates the relationship between innovation ambidexterity and business sustainability such that a very high level of ambidextrous leadership strengthens the positive effect of innovation ambidexterity on business sustainability.*

2.3.3 Moderating role of managers' attitudes toward sustainability

Business sustainability may not be driven solely by innovation, but in all likelihood is also contingent on or associated with managers' attitudes toward sustainability. The literature of sustainability identifies managers' attitudes as a factor for minimization of resource usage (i.e., economic sustainability) and pollution prevention (i.e., environmental sustainability). For

example, Papagiannakis and Lioukas (2012) show that managers' attitudes influence the firm's ability to respond to natural environment issues. Dibrell et al. (2011) show that managers with positive attitudes toward the environment are more aware of sustainability-related challenges and may be proactive to manufacture products that cause less detrimental impacts to the environment or promote environmental performance of production processes.

Attitudes toward a behavior have a significant influence on a person's evaluation of that behavior and arise from beliefs about the consequences resulting from its performance (Cordano & Frieze, 2000). Ajzen (1991) argues that intention to perform a behavior increases as an individual's attitudes toward the behavior become more favorable. Drawing on Ajzen (1991) we define business unit manager's attitudes toward sustainability as the degree to which a business unit manager has a favorable or unfavorable evaluation or appraisal of sustainability.

When managers have strong attitudes toward sustainability, they will focus on activities that minimize the adverse impacts of their firms' operations on the environment and monitor changes in sustainability-related issues. Managers with strong focus on the environment, encourage subordinates to enlarge the field of knowledge considered relevant by a firm and widen the awareness of ideas and opportunities presented by innovative activities (Dibrell et al., 2011). Therefore, managers with more positive attitudes towards sustainability are more likely to increase the number of innovative ideas that seek to improve business sustainability. As such, the impact of innovation ambidexterity on business sustainability increases. However, when managers have negative or unfavorable attitudes toward sustainability, they less possibly motivate subordinates to behave in an environmentally responsible way. Accordingly, these subordinates are less likely to adopt ideas and opportunities presented by radical and incremental innovation and thus may fail to create the opportunity to increase business sustainability. Therefore, the impact of innovation ambidexterity on business sustainability

decreases. It is expected that managers' positive attitudes toward sustainability will interact with innovation ambidexterity to enhance business sustainability, suggesting that,

H3: Managers' positive attitudes toward sustainability positively moderate the relationship between innovation ambidexterity and business sustainability, such that when attitudes are more positive toward sustainability they strengthen the positive effect of innovation ambidexterity on business sustainability.

2.4 Methodology

2.4.1 Sample and data collection

The heavy manufacturing sector in an emerging country was chosen as the sample frame for this study because of its significant negative impacts on the environment and intensive use of resources (Yuan et al., 2018; Press, 2007). Recent reports show that since 1988 over 70% of the world's greenhouse gas has been emitted by firms operating in this sector (Griffin, 2017). Moreover, in focusing on our specific sector, we also focused on a specific country setting – Iran, where the heavy manufacturing sector dominates the economy. Iran is one of the most industrialized Middle-Eastern economies and has been identified as one of the Next-Eleven emerging countries (Heirati & O'Cass, 2016; Wilson & Stupnytska, 2007). As one of the Next-Eleven emerging countries Iran has placed high priority on innovation across both manufacturing and service sectors (Scaringella & Burtschell, 2017).

The Next-Eleven countries are the next wave of emerging countries that have a high potential of moving into the world's top-20 economies by 2025 (Martin, 2012), act as a bridge between developed countries and developing (and underdeveloped) countries (Kvint, 2009). Therefore, as the world is pushing for economic growth in developing and underdeveloped countries (Kinto et al., 2017), what happens in the Next-Eleven countries can be seen as examples of what may happen for those economies coming behind the Next-Eleven

and show the way forward in terms of an economic path to growth and prosperity without destroying the environment and wasting resources. How to protect developing and underdeveloped economies and citizens from the pressures of unsustainable production should be a priority for the global community.

Using a list of firms provided by the Iran Chamber of Commerce, we identified 310 heavy manufacturing firms. We contacted the CEOs of the firms and provided them with an overview of the study and asked them to participate. To encourage participation the CEOs were offered a summary of the findings upon the completion of the study. If they agreed, we asked them to provide a list of production managers and logistics managers (who we judged would have knowledge about the issues under study). Out of 310 firms, 140 firms agreed to participate and we obtained a total of 490 contacts of production managers and 450 logistics managers.

Following Yu et al. (2013), before distributing the questionnaires, we contacted the production and logistics managers through email and phone calls to ensure their level of knowledge and gain their initial agreement to participate. A cover letter stating the purpose of the study was attached to all questionnaires. Follow-up calls were made to participants to complete and return the questionnaires and to clarify any potential ambiguities. A total of 370 completed questionnaires from production managers (a response rate of 75.5%) and 346 completed questionnaires from logistics managers (a response rate of 76.9%) were received. The analysis of the respondents indicated that petrochemical firms constituted 32.7%, iron and steel 15.5%, cement 13.6%, tire and rubber 13.6%, oil and gas 7.3%, electronics 7.3%, and other industries 10% of the firms. Further, most firms had more than 300 full-time employees and had been operating for more than 20 years.

We checked non-response bias by conducting the extrapolation technique proposed by Armstrong and Overton (1977). Comparing early and late responses we found no significant variance among three key characteristics (e.g., industry type, number of years in business, and

number of employees) at ρ<.05. Further, conducting t-test also showed no significant difference (ρ<.05) across the three key characteristics between responding and non-responding firms which at the beginning refrained from participation, and later returned the completed questionnaires. Thus, non-response bias in the sample is not a concern.

Besides having multiple informants, potential common method bias was minimized by assuring the participants of response anonymity and confidentiality to decrease social desirability responses. To diminish information apprehension, participants were also informed that there were no right or wrong answers (see Podsakoff et al., 2003). In addition, adopting similar logic to Wong et al. (2013), we placed questions related to dependent and independent variables in different surveys.

2.4.2 Questionnaire design and measure

The original surveys were developed in English, and then translated into Persian and back-translated into English using independent certified translators (see Luo et al., 2016). We conducted a pilot study using a sample of managers in Iran. We asked respondents to not only complete the surveys, but also to provide feedback about the design and wording following procedures outlined by Zhao et al. (2015). Building on the pretest, some editorial changes were made to improve clarity of questions and instructions in the surveys.

We used well-established measures from the existing literature. In the production managers' survey, three items measuring radical and three measuring incremental innovation were adopted from Lin et al. (2013). As a part of survey design, respondents were provided with a short description of radical and incremental innovation and an example of each. Following prior studies (e.g., Lin et al., 2013; Cao et al., 2009) we created the product term of radical and incremental innovation to operationalize the combined dimension of ambidexterity. Radical and incremental innovation were mean-centered to minimize the potential threat of multicollinearity (Aiken & West, 1991).

Further, in the production managers' survey, managers' attitudes toward sustainability were measured using seven items adopted from Cordano and Frieze (2000). Business sustainability was measured via 11 items adopted from Zhu et al. (2010). Transformational and transactional leadership were measured in both production managers and logistics managers' surveys. Transformational leadership was measured via 7-items adopted from Carless et al. (2000) and transactional leadership was measured via the 4-items adopted from Chang et al. (2015). Adopting similar logic to Luo et al. (2016), we operationalized ambidextrous leadership as interaction between transformational and transactional leadership by computing the product term of the two constructs. Transformational and transactional leadership were also mean-centered before obtaining their product term.

We used firm size and age as control variables in our model. Firm size was measured by the logarithm of the number of full-time employees and firm age was measured by the logarithm of the number of years since the firm was founded. Further, to ascertain that endogeneity is not an issue in this study, we used technological turbulence and length of respondents' tenure in the relevant industry as instruments. Technological turbulence was measured via 3 items reflecting the rate of technological change and instability in the technological environment (Troilo et al., 2014). We also used the logarithm of the number of years since the respondents entered the industry to measure length of respondents' tenure.

Because the data were collected from multiple production and logistics managers within each business unit nested within firms (we had no fewer than 2 production managers and 2 logistics managers in each business unit), respondents' individual scores on each construct were aggregated, and the mean response for each item was computed (Keller, 1986). To assess the variance in judgments related to the same firm we computed the interrater agreement score r_{wg} index (James et al., 1984) and then intraclass correlation (ICC). The r_{wg} values for all variables are above the cut-off value .70, and the ICC values are greater than .60, indicating satisfactory internal consistency (Schneider et al., 1998).

2.4.3 Reliability and validity

As presented in Table 2.1, the factor loadings of all items were higher than the benchmark of .50, providing support for convergent validity (Bagozzi & Yi, 1988). The average variance extracted (AVE) of all constructs was above the benchmark of .50, implying further support for convergent validity (Fornell & Larcker, 1981). The composite reliability (CR) ranging from .83 to .95, exceed the recommended level of .70 (Nunnally, 1978), indicating that the reliability of the measures is acceptable. The assessment of discriminant validity was undertaken in two ways. First, discriminant validity was assessed by comparing the square root of the AVE to the correlation between the constructs (Fornell & Larcker, 1981). As shown in Table 2.2, the square root of the AVE values were higher than all corresponding correlations. Second, following Ngo and O'Cass (2012) discriminant validity was also examined by comparing the scores of individual correlations to their respective reliabilities. As presented in Table 2.2, no individual correlations were greater than their respective reliabilities, hence indicating satisfactory discriminant validity of all constructs. Table 2.1 shows the means, standard deviations, correlations between constructs, and square root of AVE. Altogether, the results showed that the measures in this study possess acceptable reliability and validity.

Table 2.1 Standard estimates and coefficient alpha

Constructs	Item	Loading
Radical innovation[a] *CR=.91; AVE=.76*	*Over the last three years, compared to the previous three years…*	
	this firm frequently introduced radical new products and/or processes.	.87
	this firm introduced more radical new products and/or processes.	.88
	the percentage of new radical product and/or process innovations implemented in this firm was greater.	.87
Incremental innovation[a] *CR=.83; AVE=.62*	*Over the last three years, compared to the previous three years…*	
	this firm frequently introduced incremental new products and/or processes.	.78
	this firm introduced more incremental new products and/or processes.	.79
	the percentage of new incremental product and/or process innovations implemented in this firm was greater.	.78

Table 2.1 Standard estimates and coefficient alpha

Constructs	Item	Loading
Attitudes toward sustainability[a] *CR=.90; AVE=.60*	*I personally believe…*	
	sustainability is not necessary to achieve high levels of environmental and economic performance (R).	.73
	sustainability is an important component of a firm's management strategy.	.70
	sustainability is not an important component of manufacturing management (R).	.83
	sustainability should be seen as an important component of a firm's bottom line.	.73
	sustainability is an ineffective management strategy (R).	.71
	sustainability improvement is the most desirable waste management goal.	.84
	most sustainability projects are worthwhile.	.81
Transformational leadership[b] *CR=.94; AVE=.72*	*My CEO…*	
	communicates a clear and positive vision of sustainability.	.82
	supports and encourages staff to foster sustainability.	.83
	gives encouragement and recognition to staff who promote and support sustainability.	.86
	fosters involvement and cooperation among team members to promote sustainability.	.84
	encourages thinking about sustainability problems in new ways and questions assumptions that discourage sustainability.	.89
	is clear about his/her values and practices what he/she preaches in regards to sustainability.	.86
	instills pride and respect in staff who support sustainability.	.85
Transactional leadership[c] *CR=.90; AVE=.72*	*My CEO…*	
	points out what I will receive if I do what is required to enhance sustainability.	.90
	tells me what to do to be rewarded for my efforts to enhance sustainability.	.91
	is alert for failure to meet standards to enhance sustainability.	.85
	works out agreements with me on what I will receive if I do what needs to be done to enhance sustainability.	.71
Business sustainability[d] *CR=.95; AVE=.66*	*Over the past year, our firm has…*	
	reduced air emissions.	.77
	reduced waste water.	.82
	reduced solid wastes.	.86
	decreased consumption for hazardous/ harmful/ toxic materials.	.83
	decreased frequency of environmental accidents.	.86
	improved firm's environmental situation.	.76
	decreased costs for materials purchasing.	.60
	decreased costs for energy consumption.	.73
	decreased fees for waste treatment.	.86
	decreased fees for waste discharge.	.88
	decreased fines for environmental accidents.	.83
Technological turbulence[e] *CR=.86; AVE=.69*	*Over the last three years, in our industry…*	
	it was very difficult to forecast technology development.	.86
	the technology environment was very uncertain.	.84
	the technology developments were highly unpredictable.	.79

Notes: "R" indicates reverse coding.

[a]The scale format for each of these measures was 1="Strongly disagree" and 5="Strongly agree".

[b]The scale format for each of these measures was 1="Rarely or never" and 5="Very frequently if not always".

[c]The scale format for each of these measures was 1="Not at all" and 5="Very much so".

[d]The scale format for each of these measures was 1="Not at all" and 5="Significantly".

[e]Variable used as an instrument for the assumed endogenous variable.

Table 2.2 Descriptive statistics and correlations among variables

Variables	CR	M	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12
1. Radical innovation	.91	2.82	.80	1.00	5.00	**.87**											
2. Incremental innovation	.83	3.21	.66	1.50	5.00	.42**	**.79**										
3. Innovation ambidexterity	N/A	.31	.52	N/A	N/A	.17	.15	N/A									
4. Attitudes toward sustainability	.90	4.04	.40	2.71	5.00	.09	.05	.16	**.77**								
5. Transformational leadership	.94	3.14	.56	1.76	4.32	.07	.20*	.14	.16	**.84**							
6. Transactional leadership	.90	3.00	.49	1.91	4.25	.17	.32**	.19*	.04	.36**	**.84**						
7. Ambidextrous leadership	N/A	.18	.31	N/A	N/A	.12	.26*	.20*	.10	.25*	.21*	N/A					
8. Business sustainability	.95	3.13	.68	1.70	5.00	.19*	.15	.37**	.14	.15	.24*	.14	**.81**				
9. Firm age	N/A	N/A	N/A	N/A	N/A	-.01	-.06	-.02	.00	-.03	.05	.00	.07	N/A			
10. Firm size	N/A	N/A	N/A	N/A	N/A	.18	.10	.09	.14	.11	-.02	.00	-.03	.16	N/A		
11. Technological turbulence[a]	.86	3.73	.60	1.00	5.00	.19*	.25*	.16	.02	.07	.21*	.12	.08	.05	.03	**.83**	
12. Length of tenure[a]	N/A	N/A	N/A	N/A	N/A	.13	.17	.12	.20*	.16	-.02	-.10	.02	-.04	-.03	-.06	N/A

Notes: M= mean; SD= standard deviation; square root of AVE is on the diagonal.
* ρ< .05, ** ρ< .01 (two-tailed).
[a]Variable used as an instrument for the assumed endogenous variable.

2.5 Results

We employed polynomial regression with response surface analysis (Edwards, 1994) to test our hypotheses[7]. This technique allows researchers to investigate how different combinations of two components (i.e., radical innovation and incremental innovation) of a composite construct (i.e., innovation ambidexterity) can influence a dependent variable (Lee et al., 2017).

As noted by Shanock et al. (2010) prior to conducting polynomial regression analysis, it is important to ensure there is discrepancies between the two components. The initial analysis of discrepancies test revealed that forty percent of the dataset indicate symmetry in innovation practices (difference between standardized scores of radical and incremental innovation is less than half a standard deviation). In contrast, twenty-eight percent indicate asymmetry in

[7] Polynomial regression analysis is appropriate given that all variables in this study are continuous.

innovation practices in which radical innovation is more than incremental innovation, and thirty-two percent indicate asymmetry in innovation practices in which incremental innovation is more than radical innovation. Thus, applying polynomial analysis for testing the effect of combination of components of innovation ambidexterity on sustainability is appropriate (see Herhausen, 2016).

Following the same procedure as outlined by Shanock et al. (2010) three steps were conducted in running polynomial regression analysis. First, the mean-centered values of all indicators (i.e., radical and incremental innovation, ambidextrous leadership, and managers' attitudes toward sustainability) were used to aid interpretation and alleviate the potential concern of multicollinearity. Second, business sustainability was regressed on five polynomial terms including each of the two predictors (i.e., radical and incremental innovation), their product term, and the squared term of each predictor. Third, rather than interpreting the regression coefficients that relate to the effect of each polynomial term on business sustainability, we used them to compute the response surface plot.

2.5.1 Main effect

We developed several models to test the hypotheses and the results are presented in Table 2.3. Predictability of the models was assessed using R^2. In Model 1 we added firm size and age as control variables ($R^2 = .04$). The results indicate no control variables were related to business sustainability.

H1 suggests that innovation ambidexterity is positively related to business sustainability. This means business sustainability increases as both radical and incremental innovation increase simultaneously. We tested this hypothesis by adding five polynomial terms in equation (1) shown below where RAD and INC represent radical and incremental innovation, respectively.

(1) Business sustainability = $b_0 + b_1$ (RAD) + b_2 (INC) + b_3 (RAD^2) + b_4 (RAD×INC) + b_5 (INC^2) + e

Adding the polynomial terms in Model 2, resulting in a 25% increase in R^2, supporting strong predictability power of the regression model. H1 can be tested by identifying a positive slope along the symmetry line on which radical innovation equals incremental innovation. Thus, equation (1) can be replaced by the following equation (2) where ($b_1 + b_2$) represents the linear slope along the symmetry line which should be positive and significant, while ($b_3 + b_4 + b_5$) represents the curvature pattern along the symmetry line should be insignificant.

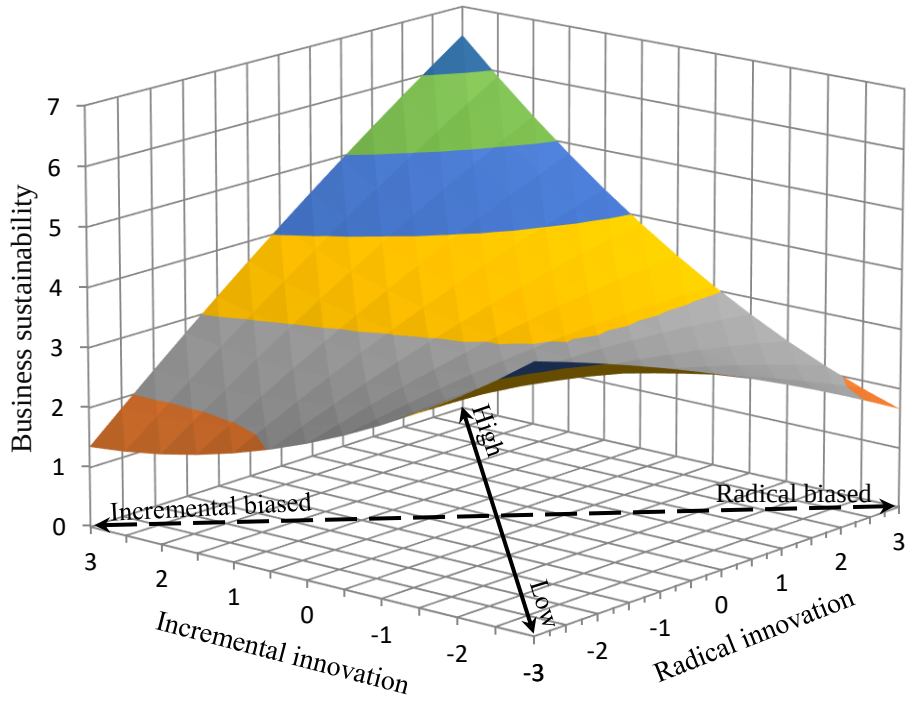
(2) Business sustainability = $b_0 + (b_1 + b_2)$ RAD + $(b_3 + b_4 + b_5)$ RAD^2 + e

The lower half of Table 2.3 shows the linear slope along the symmetry line is significant and greater than 0 (.35, $\rho<.01$) and the curvature pattern along the symmetry line is insignificant (.27, $\rho>.1$). We further investigated if business sustainability increases (or decreases) when deviations in radical and incremental innovation from the perfect symmetry line would be in opposite directions (i.e., radical innovation = – incremental innovation). Thus, equation (1) can be replaced by the following equation (3) where ($b_1 – b_2$) representing the linear slope along the asymmetry line and ($b_3 – b_4 + b_5$) representing the curvature pattern along the asymmetry line.

(3) Business sustainability = $b_0 + (b_1 – b_2)$ RAD + $(b_3 – b_4 + b_5)$ RAD^2 + e

As shown in the lower half of Table 2.3, business sustainability has a non-significant relationship along the asymmetry line (.05, $\rho>.1$) and a non-significant curvature too (–.17, $\rho>.1$). Figure 2.2 shows the resulting three-dimensional plot of the response surface along the lines of symmetry (solid line) and asymmetry (dashed line). Together these results offer strong support for H1.

Figure 2.2 Response surface analysis to test H1



Notes:⟷symmetry line: from low to high ambidexterity;⟷asymmetry line: from balanced (center) to unbalanced innovation practices (corners)

2.5.2 Moderating effects

To test the moderated model, we employed the principles of moderated regression (e.g., Aiken & West, 1991) in polynomial regression analysis as outlined by Menguc et al. (2016) and Vogel et al. (2016). Equation (4) below is a polynomial regression equation employed to test the moderated model where M represents the moderator, $[b_1 + b_2 + M (b_7 + b_8)]$ represents the linear slope along the symmetry line, and $[b_3 + b_4 + b_5 + M (b_9 + b_{10} + b_{11})]$ represents the curvature pattern along the symmetry line.

(4) Business sustainability = $(b_0 + b_6M) + [b_1 + b_2 + M (b_7 + b_8)]$ RAD + $[b_3 + b_4 + b_5 + M (b_9 + b_{10} + b_{11})]$ RAD^2 + e

We tested the moderation effect of ambidextrous leadership (H2) by adding ambidextrous leadership and the interaction of ambidextrous leadership with each polynomial

term to run Model 3 and Model 4, respectively. As Table 2.3 shows, the predictive power (R^2) of the regression model increases with each step, resulting in 29% in Model 3 and 35% in Model 4. We then used the regression coefficients from Model 4 to compute the slope along the symmetry line at high and low levels of ambidextrous leadership by substituting values one standard deviation above and below the mean of ambidextrous leadership into equation (4). As indicated in Table 2.3, at low level of ambidextrous leadership, the slope along the symmetry line is insignificant (.24, $\rho>.1$), whereas at a high level of ambidextrous leadership the slope along the symmetry line is positive and significant (.44, $\rho<.01$). As shown in Figure 2.3 (Plot A) the effect of innovation ambidexterity on business sustainability is stronger in the case of CEOs who engage in ambidextrous leadership behavior. These results provide support for H2.

We employed the same procedure to test the moderation effect of managers' attitudes toward sustainability (H3) to run Model 5 and Model 6. As Table 2.3 shows, the predictive power of the regression model increases with each step, resulting in 35% in Model 5 and 42% in Model 6. As shown in the lower half of Table 2.3, at low level of attitudes toward sustainability, the slope along the symmetry line is insignificant (.13, $\rho>.1$), whereas at high level of attitudes toward sustainability, the slope along the symmetry line is positive and significant (.40, $\rho<.01$). Figure 2.3 (Plot B) reveals the positive effect of innovation ambidexterity on business sustainability is enhanced more rapidly when managers in business units have more positive attitudes toward sustainability. These results lend support to H3.

Table 2.3 Results - Polynomial regressions and response surface analysis

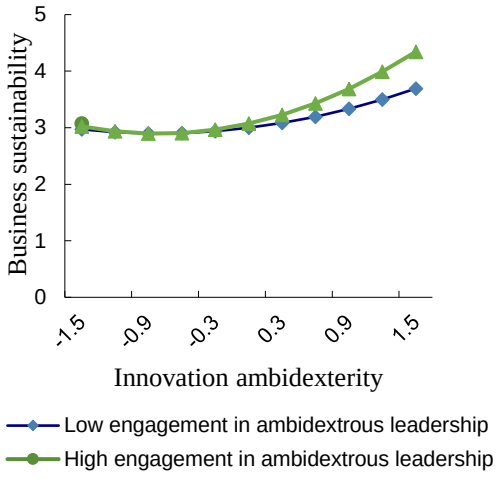
	Business sustainability					
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Control variables						
Firm size	-.02	.06	.06	.04	.05	.03
Firm age	.04	.03	.05	.04	.05	.04
Polynomial regression						
RAD		.20*	.19*	.18*	.19*	.16
INC		.15	.16	.16	.14	.10
RAD^2		-.02	.01	.01	-.02	-.05
RAD × INC		.22*	.21	.17	.21*	.15
INC^2		.07	.05	.03	.10	.09
Moderating variables						
Ambidextrous leadership			.16	.12		
Attitudes toward sustainability					.19	.17
Interactions						
RAD × Ambidextrous leadership				.21*		
INC × Ambidextrous leadership				.11		
RAD^2 × Ambidextrous leadership				-.06		
RAD × INC × Ambidextrous leadership				.19		
INC^2 × Ambidextrous leadership				.07		
RAD × Attitudes toward sustainability						.18*
INC × Attitudes toward sustainability						.15
RAD^2 × Attitudes toward sustainability						.01
RAD × INC × Attitudes toward sustainability						.12
INC^2 × Attitudes toward sustainability						.06
R^2	.04	.25	.29	.35	.35	.42
ΔR^2		.21	.04	.06	.10	.07

Surface tests	Business Sustainability	Ambidextrous leadership		Attitudes toward sustainability	
		Low	High	Low	High
Slope symmetry line	.35**	.24	.44**	.13	.40**
Curvature symmetry line	.27	.15	.27	.11	.26
Slope asymmetry line	.05	-.05	.10	.04	.08
Curvature symmetry line	-.17	.06	.26	.23	.04

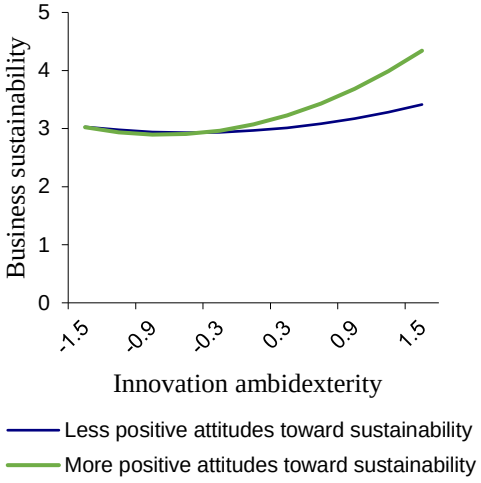
Notes: * ρ< .05, ** ρ< .01.
RAD = Radical innovation; INC = Incremental innovation
R^2 and ΔR^2 to test the moderation effect of managers' attitudes toward sustainability (Model 5 and Model 6) are based on the changes in variance explained compared to the model excluding ambidextrous leadership.

Figure 2.3 Response surface analysis to test H2 and H3

Plot A. Moderator: Ambidextrous leadership



Plot B. Moderator: Managers' attitudes toward sustainability



2.5.3 Endogeneity

Consistent with prior research (e.g., Wang et al., 2016), we accounted for the potential of endogeneity in three ways (e.g., control for measurement error, decrease the possibility of simultaneous effects, and using instrumental variables). *Control for measurement error at design stage:* we sought to decrease measurement error that may endanger the validity of the relationship between the measures by collecting data from multiple informants. We also divided dependent and independent variables across different surveys and also different respondents provided responses to some constructs and not others (see Wong et al., 2013). *Decrease the possibility of simultaneous effects:* the issue of simultaneity appears when independent and dependent variables simultaneously affect each other (Antonakis et al., 2014). The literature supports the view that innovation is an antecedent of firm's business sustainability (e.g., Silvestre, 2015). Therefore, we are confident that the path is from innovation ambidexterity to business sustainability and not vice versa. As such, theoretically, the study is free of simultaneity concern. *Using instrumental variables:* following the procedures outlined in Liu et al. (2016) two-stage least squares (2SLS) regression with

instrumental variables was adopted. We used firm size, technological turbulence, and length of tenure of respondents as instruments for innovation. We calculated the predicted values of the assumed endogenous variable of innovation ambidexterity and then applied it to test the relationship between innovation ambidexterity and business sustainability. The results show the relationship between innovation ambidexterity and business sustainability is positive and significant ($\beta = .38$, $\rho<.01$). After running the 2SLS, we conducted a Durbin-Wu-Hausman post-estimation test of endogeneity. According to the test results, the path coefficient of the error term of innovation ambidexterity to business sustainability is insignificant ($\rho>.1$), indicating that our results are unlikely to be influenced by endogeneity.

2.6 Discussion and implications

Increasing numbers of manufacturing firms in emerging countries are developing sustainability strategies in concert with host governments enacting tighter environmental controls to ensure that manufacturers have requirements for the environment built into their operations (Esfahbodi et al., 2016). With the greater emphasis on environmental and sustainability issues instituted by government bodies, environmental protection agencies, and customers it is important to understand how manufacturers in emerging countries including Next-Eleven countries are working to achieve this objective and can be better support sustainability efforts. In this study, we unpack the mechanisms by which innovation ambidexterity enhances business sustainability. Our focus is beneficial to not only industry, but also society in addressing the challenges that emerging countries are facing with the rapid pace of economic development and its impacts on resource consumption, waste and pollution from manufacturing industries. With our focus on innovation and sustainability, we bring critical attention to the contingent role of managers in fostering innovation and sustainability, especially the role CEOs' leadership style and business unit managers' attitudes toward

sustainability. From a sample of production managers and logistics managers of heavy manufacturing firms, we provide support for our theory and provide three contributions to the innovation and sustainability literature.

First, while the existing literature focuses largely on financial performance being a beneficial outcome of ambidexterity (e.g., Lin et al., 2013; Zhang et al., 2016; Tan & Liu, 2014), limited attention has been given to unpacking the mechanisms by which radical and incremental innovation, when managed ambidextrously drives business sustainability. We contribute to the existing research on innovation and sustainability by extending the scope and applicability of ambidexterity theory to the sustainability domain. In advancing the literature, we show that innovation ambidexterity constituted by high levels of radical and incremental innovation is a trigger for enhancing business sustainability. Departing from existing research that emphasizes the importance of radical innovation over incremental innovation to foster business sustainability (e.g., Klewitz & Hansen, 2014), we identify that the deployment of either radical or incremental innovation alone (separately) is not sufficient and firms need to be ambidextrous to achieve higher levels of business sustainability.

Further, our findings consolidate a point made by Sok and O'Cass (2015) who emphasized combined ambidexterity is beneficial in terms of facilitating a range of performance. Our study takes this point in a new direction particularly in the context of innovation and business sustainability by showing that firms need to pursue high levels of both radical and incremental innovation (i.e., combined view of innovation ambidexterity) to foster business sustainability. We further contribute to the literature of organizational ambidexterity by providing evidence of contextual ambidexterity's value and theoretical relevance in solving grand challenges facing industry and our planet. In advancing the literature, we examined the applicability and robustness of the consequences of contextual ambidexterity in a manufacturing setting, a setting that has a significant impact on sustainability. This insight

contributes to a better understanding of how heavy manufacturing firms can manage their innovation activities, as well as the benefits astute management brings to the business sustainability domain.

Second, in picking up on the role of management our study enriches the literature by showing that the effect of innovation ambidexterity on business sustainability is significantly improved through CEOs who engage in ambidextrous leadership. While past research has indicated the benefits of ambidextrous leadership (e.g., Luo et al., 2016; Rosing et al., 2011), our study theorizes this point in a new theoretical domain in the context of innovation and business sustainability. This study represents a step forward by indicating that the role of ambidextrous leadership constitutes a platform to communicate the benefits of firms that use radical and incremental innovation to cope with the prevailing challenges related to business sustainability in emerging countries. By positioning ambidextrous leadership as a key moderating factor in the relationship between innovation ambidexterity and business sustainability, we contribute to the literature on organizational ambidexterity by specifically focusing on two forms of ambidexterity, one is an organizational form in the context of innovation and the other is an individual form in the leadership domain. Our study further provides a more precise understanding of the important role of leaders who engage in different, but complementary leadership behaviors in seeking to facilitate the effect of innovation ambidexterity on business sustainability.

Third, prior research has highlighted the importance of managers' attitudes on implementing resource reduction activities and environmental responsiveness (e.g., Cordano & Frieze, 2000; Papagiannakis & Lioukas, 2012). Our point of departure is through investigating the potential influence of business unit managers' attitudes on the innovation-sustainability relationship. This level of theoretical analysis has received scant attention to-date. In advancing the literature, we posit that functional business unit managers' attitudes

toward sustainability play a critical role in maximizing the consequences of innovation ambidexterity with respect to business sustainability. This moderating effect is consistent with Dibrell et al. (2011) who show that top-level managers with positive attitudes toward the natural environment contribute strongly to organizational outcomes. Drawing on their limitations, we rely on a multi-informant dataset collected from broad range of industries to show more robustly that managers should be attending to the environmental concerns to strengthen the effect of innovation on business sustainability. As such, our findings provide an important behavioral perspective to the literature on organizational innovation and sustainability by highlighting the importance of sustainability attitudes held by managers who manage business unit with potentially heavy impacts on innovation and sustainability.

2.6.1 Managerial implications

From a practical perspective, this study has important managerial implications. First, traditionally to improve business sustainability, radical innovation has been considered more effective than incremental innovation (Klewitz & Hansen, 2014). Our findings are a reminder to managers of manufacturing firms in emerging countries that radical innovation alone is not enough to maximize business sustainability. They need to focus on supporting radical innovation efforts with ongoing incremental innovation that can be incorporated and synergized with radical innovation to propel and create the impetus for business sustainability. We further advise managers to combine an appropriate set of practices and investing available resources (e.g., hiring new employees, developing teams) to pursue both radical and incremental innovation at the same time. Doing so enables managers to avoid falling into a 'success trap' that stifles radical innovation or 'failure trap' that stifles incremental innovation (Gibbert, 2005). This strategy may be achievable by organizing educational programs to help

managers to understand the value of both radical and incremental innovation for the superior business sustainability and how to manage their units to maximize both outcomes.

Second, our study suggests that firms operating in a sector that significantly impacts the environment need to be more aware of the power of their CEOs' leadership in supporting innovation-sustainability. Our study indicates that if CEOs do not shape the strategic direction of their firm through considering both transformational and transactional behaviors, their ability to use innovation ambidexterity to drive business sustainability will be restricted. Thus, CEOs are advised to recognize their own leadership style and develop different, but complementary leadership behaviors that match evolving business environment needs. We recommend that CEOs ambidextrously manage both leadership styles to direct their subordinate managers to further bolster the relationship between innovation ambidexterity and business sustainability.

Third, our results provide a useful signal to firms that they should be aware that managers' attitudes toward sustainability play an important role in communicating and unlocking the potential of innovation ambidexterity to support business sustainability. Accordingly, firms need to evaluate their business unit managers' attitudes and set clear strategies aimed at reshaping the unfavorable managerial attitudes toward sustainability in a more favorable way to maximize the benefits of innovation ambidexterity. As such, we advise top management teams of manufacturing firms to put in place training workshops to create an environment in which business unit managers are encouraged to consider environmental concerns and sustainability-related challenges in their operations. In addition, these firms are advised to consider in the recruitment process managers' attitudes toward the environment and sustainability.

2.6.2 Limitations and conclusion

This study has specific limitations that need to be acknowledged. First, this study relied on data from cross-sectional surveys which limits causal inferences being drawn. Longitudinal data would be appropriate to tackle this issue, given that the variables in our model are subject to change. This is especially so with our focus on managers' attitudes towards the environment and sustainability which are susceptible to change (Stern, 2000). Second, in operationalizing radical and incremental innovation and business sustainability we used subjective measures relying on managers' self-reports. Future studies may consider using objective measures of radical and incremental innovation (such as investments in R&D or turnover from introducing radical and incremental new products and processes) and business sustainability (such as how much energy or raw material are used) over time. Third, this study was conducted in a single national context, Iran, a Next-Eleven economy. It is possible that certain characteristics originating from the geographical context affected our results. Future research is needed to replicate or extend our findings within other country settings.

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Chapter 3

Driving business to business brands: Signal your sustainability and manage your customer relationships and attitudes

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Abstract

The rapid rate of economic development in emerging countries has resulted in a growing range of challenges leading to greater effort being directed to better resource use, protecting the environment and supporting business sustainability. These challenges coupled with growing pressures from environmental activists and governments enacting tighter environmental controls, have forced manufacturing firms in emerging countries to adopt sustainability practices into their business strategies. Despite mounting pressure on the environment and the growing importance of sustainability in emerging countries, little emphasis has been placed on capturing the value from pursuing sustainability to enhance a manufacturer's brand image and market performance in business-to-business (B2B) markets. This is surprising given the growing numbers of customers preferring to purchase brands that demonstrate concern for the environment and sustainability. Using signaling theory, we examine the extent to which a firm's pursuit of sustainability underpins its brand image as perceived by its business customers, which in turn, promotes its market performance. In addition, we examine the roles of customer relationship management (CRM) and customers' attitudes toward sustainability in fostering the relationship between sustainability practices and brand image. Drawing on a multi-informant dataset collected from B2B manufacturing firms and their customers, we show that sustainability practices significantly drive brand image and this relationship is contingent on CRM and customers' attitudes toward sustainability. The results also show that manufacturing firms with a positive brand image have higher levels of market performance by reducing information costs for customers and lowering their perceived risk of purchase. The results extend the marketing literature and provide significant managerial implications for practitioners to better understand and communicate the consequences of their investment in their sustainability practices.

Keywords: sustainability, brand image, customer relationship management (CRM), customer's attitudes

3.1 Introduction

With lower labor and raw material costs, as well as good growth prospects, manufacturing in emerging countries[8] has grown dramatically over recent years (Geng, Mansouri, Aktas, & Yen, 2017; Rauch, Dallasega, & Matt, 2016). Although there has been benefits from the significant growth in production in emerging countries which has led to continued growth and economic prosperity, problematically this has also placed them at the forefront of sustainability concerns as a result of their intensive use of natural resources and environmental degradation (Esfahbodi, Zhang, & Watson, 2016; Lai, Wong, & Lun, 2014). Accordingly, manufacturers in emerging countries are adopting sustainability practices into their business strategies, as their governments enact tighter environmental controls to reduce the detrimental effects of manufacturers' operations on the natural environment (Esfahbodi et al., 2016). While external forces are pushing business-to-business (B2B) manufacturers at a rapid pace toward sustainability, in many respects manufacturers in emerging countries still lack a clear understanding of the implications of their investments in sustainability in terms of what benefits may accrue to marketing assets, especially their brand as a major asset.

Prior research studying business-to-customer (B2C) markets implies that adoption of sustainability practices, such as prevention of pollution and reduced consumption of energy and natural resources provide a significant basis for firms to strengthen their brand equity (Chen, 2010; Olsen, Slotegraaf, & Chandukala, 2014). However, related research in B2B markets is scant compared to that in B2C markets. The paucity of empirical research regarding the branding consequences of sustainability in the B2B context is surprising given that two major characteristics make B2B and B2C markets distinctly different from each other. First, the impact of concerns over the environment is more observable in the B2B context (Mariadoss,

[8] According to Rauch et al. (2016) emerging countries include up and coming Asian nations, countries from Latin America and Africa and some Eastern European states. Some of these countries are referred to by the acronyms BRICS (Brazil, Russia, India, China, and South Africa), RDE (Rapidly Developing Economies), N-11 (Next Eleven), and MENA (Middle East and North Africa).

Tansuhaj, & Mouri, 2011), and second the monetary value of sales in B2B markets far exceeds that in B2C markets (Homburg, Klarmann, & Schmitt, 2010; Sheth & Sinha, 2015). The noted differences impede the generalizability of findings of B2C studies to B2B contexts and highlight the need for greater attention to B2B research at the intersection of sustainability and branding. This is especially important as recent literature highlights that business customers favor firms with higher commitment to sustainability. Some reasons offered for this are business customers' growing awareness of protecting the environment and the seriousness of environmental issues (e.g., Kumar & Christodoulopoulou, 2014; Sharma, Iyer, Mehrotra, & Krishnan, 2010). Therefore, we focus on studying the conditions under which the implementation of sustainability practices in B2B manufacturing firms improve business customers' brand image, and the extent brand image contributes to the manufacturing firms' market performance.

It has been highlighted that the perceptions and the reputation of a firm regarding sustainability, depends not only on the firm's operations, but may also depend on its supply chain partners' views and relationships with it. Surprisingly, the sustainability literature has overwhelmingly focused on managing relationships with suppliers (e.g., Leppelt, Foerstl, Reuter, & Hartmann, 2013; Zailani, Jeyaraman, Vengadasan, & Premkumar, 2012). There has been a distinct lack of research investigating whether (and to what extent) management of customer relationships contributes in the branding consequences of sustainability practices. This is particularly salient for B2B manufacturing firms as customer relationships have never been as interactive as they are in today's environment (Wang, Capon, Wang, & Guo, 2017). Further, more broadly previous research reports that customers with positive attitudes toward sustainability are more interested in products with minimum consumption of energy in their production processes and that cause less pollution (harm) to the environment (Jaiswal & Kant, 2018; Chen, 2015). Yet, at present it is largely unknown if customer relationship management

(CRM) and customers' attitudes toward sustainability enhance the value of sustainability practices to brand image as perceived by business customers.

In addressing the extent sustainability practices contribute to a B2B firm's brand image, we address the following questions. Does pursuit of sustainability improve a B2B firm's brand image? Does managing business customer relationships (CRM) help B2B firms in signaling sustainability and building brand image? Do business customers' attitudes toward sustainability help B2B firm build brand image? And finally, does a B2B firm's brand image contribute to its market performance?

Our investigation of these questions contributes to the sustainability and branding literature in four specific ways. First, relying on signaling theory we unpack the relationship between sustainability practices and brand image in B2B markets in an emerging country. Signaling theory is premised on the view that signals such as a firm's values are an effective means to overcome customers' uncertainty caused by a lack of information about the firm or its products. Signals may reduce customers' risk perceptions, and guide their decision making and add value to the firm's reputation (Brach, Walsh, & Shaw, 2018; Sharma, Davcik, & Pillai, 2016). With this contribution we also respond to calls in the literature (e.g., Kumar & Christodoulopoulou, 2014; Sheth & Sinha, 2015) for exploring the importance of sustainability in B2B branding. This is important because many B2B firms are increasingly blamed and face loss of legitimacy and trust because they are considered to be thriving at the expense of societies where they conduct their businesses (cf., Sheth & Sinha, 2015). Understanding the extent that sustainability practices enhance brand image can better direct a firm's attention to its sustainability activities in driving brand success and improving long-term performance.

Second, sustainability literature highlights the role of customers in enabling firms to improve their competitive position derived from adopting sustainability practices (e.g., de Sousa Jabbour, Vazquez-Brust, Jabbour, & Latan, 2017; Junquera, del Brío, & Fernández).

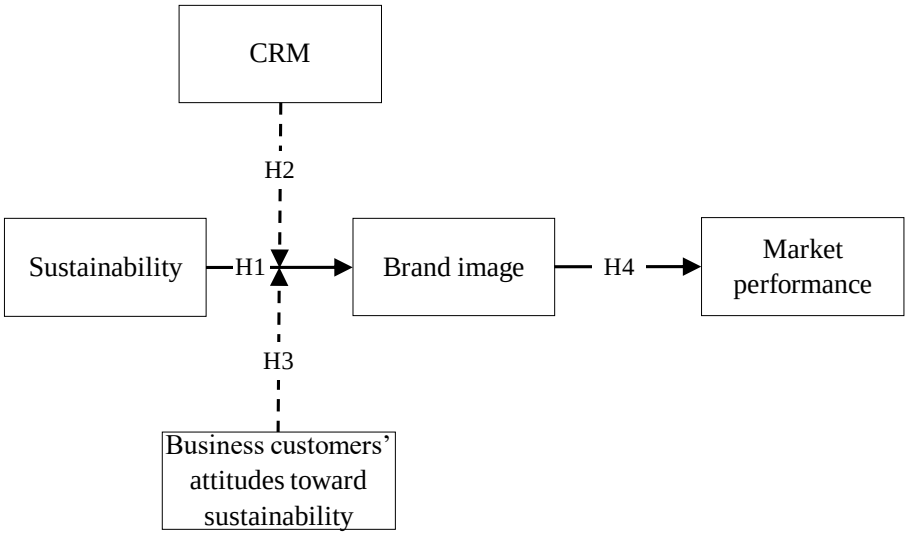
However, B2B marketing research has not included CRM and customers' attitude toward sustainability in relation to the role of firms' sustainability practices in developing their brand images. This research views CRM and customers' attitudes toward sustainability as key boundary conditions that impact strength of the connection between sustainability practices and brand image. Unpacking the extent that a firm's customers contribute to helping sustainability improve brand image is critical in emerging countries for two reasons. First, a lack of infrastructure and the socio-economic conditions in emerging countries place greater responsibilities on firms' shoulders for market and regional development (Sheth & Sinha, 2015). Second, manufacturing firms operating in emerging countries are competing to sell not only in their domestic markets, but they also increasingly service global markets which are much more sensitive to the environment and sustainability issues (Esfahbodi et al., 2016). As such, we extend the application of signaling theory by looking at the contingency role of CRM and customers' attitudes toward sustainability that support the appropriateness of and magnify signals that convey a firm's commitment to the environment and sustainability. Unpacking this complex interplay may offer strategies for B2B marketers in emerging countries to better manage their business customers to improve sustainability-based brand image.

Third, prior research has examined the effects of B2B brands on a range of performance indicators, including customers' intentions and attitudes (Cretu & Brodie, 2007; Wuyts, Verhoef, & Prins, 2009), relational outcomes (Ghosh & John, 2009), and profitability growth of manufacturers' upstream component suppliers (Worm & Srivastava, 2014). Despite research progress, the contribution of B2B brand image to the market performance of manufacturing firms have not been fully articulated, especially in emerging countries. We demonstrate how favorable brand image increases market performance in B2B markets. Market performance is an important indicator because it reflects the cost of building and sustaining a brand, enabling

a more accurate assessment of the return on B2B brand strategies. We demonstrate how strong or favorable brand image increases market performance.

Fourth, according to Worm and Srivastava (2014), research on B2B brands draws largely on single-informant survey data from specific industries. The contextual features of each industry may restrain generalizability of the findings from these studies to other situational contexts (see Homburg et al., 2010; Zablah, Brown, & Donthu, 2010). In addition, the prevailing frame of reference for research in B2B branding still has an overwhelming emphasis on developed countries contexts (Nyadzayo, Matanda, & Rajaguru, 2018). Generalizability of the practices of firms in these markets may not always occur easily, especially into the context of emerging countries (Simões, Singh, & Perin, 2015). Through adopting a multiple informant design across different industries in an emerging country context, this research provides in-depth insights not found within current literature that are specific and generalizable to a greater extent to the emerging countries context. Figure 3.1 presents the conceptual model we developed to address the identified research gaps.

Figure 3.1 Research framework



3.2 Conceptual background and hypotheses

Growing concerns about resource depletion and the environment have become an increasingly significant issue for many stakeholders including customers, industries, governments, and society at large (Chen, 2010; Gupta & Kumar, 2013). This is mainly due to resource and energy intensity in manufacturing firms around the world and the negative impact of their operations on the environment (Kang & Hur, 2012; Allwood, Cullen, & Milford, 2010). Many firms are being forced to change their behaviors and practice sustainability practices with regard to compliance with customers' increasing their demand for products produced in an environmentally friendly manner (Ng, Butt, Khong, & Ong, 2014; Olsen et al., 2014). Sustainability when viewed from a business perspective is defined as an organizational activity that is directed to reducing pollution and efficient use of energy and other resources aiming at diminishing the detrimental effects of firms' activities on the environment and human race (Gupta & Kumar, 2013). The ranking of firms, such as The Best 100 Corporate Citizens presented by Forbes, indicate these firms are strongly committed to sustainability to improve their reputation in their stakeholder communities (Gupta & Kumar, 2013). In business markets, firms are also subject to pressures from customers to adopt sustainability practices while managing their business practices (Blenkhorn & MacKenzie, 2017; Kumar & Christodoulopoulou, 2014; Sharma et al., 2010).

Commitment to sustainability has been framed by the concept of the triple bottom line (3BL) introduced by Elkington (1998) which simultaneously considers environmental, economic, and social issues from a microeconomic point of view. Environmental sustainability is related to reducing air emissions, waste water, solid waste, consumption of hazardous/harmful/toxic materials, and environmental accidents (Gimenez, Sierra, & Rodon, 2012; Zhu, Geng, & Lai, 2010). This aspect of sustainability addresses the environment, ecological concerns, global warming, waste management, and improved pollution and

emissions management (Townsend, 2008). Economic sustainability, on the other hand, refers to the efficient utilization of energy and other resources to produce long-term positive effects, while minimizing the negative effects of resource exploitation (Gotschol, De Giovanni, & Vinzi, 2014; Sheth & Sinha, 2015). Through the lens of firms, this implies the efficient use of energy and other resources to ensure long-term existence and profitability of businesses (Yusuf, Gunasekaran, Musa, El-Berishy, Abubakar, & Ambursa, 2013). Finally, social sustainability pertains to improving and maintaining people's quality of life through avoiding or reducing damage to the environment and over-exploiting natural resources (Gimenez et al., 2012; Silvestre, 2015). Social sustainability addresses beneficial and fair practices toward employees, local communities and the region in which a firm operates (Wang, Subramanian, Gunasekaran, Abdulrahman, & Liu, 2015).

Manufacturers often focus on, or start with improvements in environmental and economic dimensions in their journey toward sustainability (Du, Pan, & Zuo, 2013; Hoffenson, Dagman, & Söderberg, 2014; Wagner, 2015). This is because manufacturers often face challenges such as efficiency of resource usage and control of pollution, waste, and emissions (Gimenez et al., 2012; Yusuf et al., 2013). Addressing these challenges is important for B2B firms operating in sectors including energy, chemicals and manufacturers of key materials such as steel, cement, and plastics due to both their economic relevance (in terms to large resource and energy consumption) and their significant environmental impact (pollution, toxic waste, and industrial accidents) (Sheth & Sinha, 2015). Following previous research on sustainability, we focus our attention on environmental and economic dimensions of sustainability (e.g., Choi & Ng, 2011; Zhang, Wang, Yin, & Su, 2012).

Current literature on sustainability identifies multiple domains of research in operations and marketing, addressing a wide range of issues. For example, as shown in Figure 3.2, an analysis of the existing work on sustainability in operations research has investigated how firms

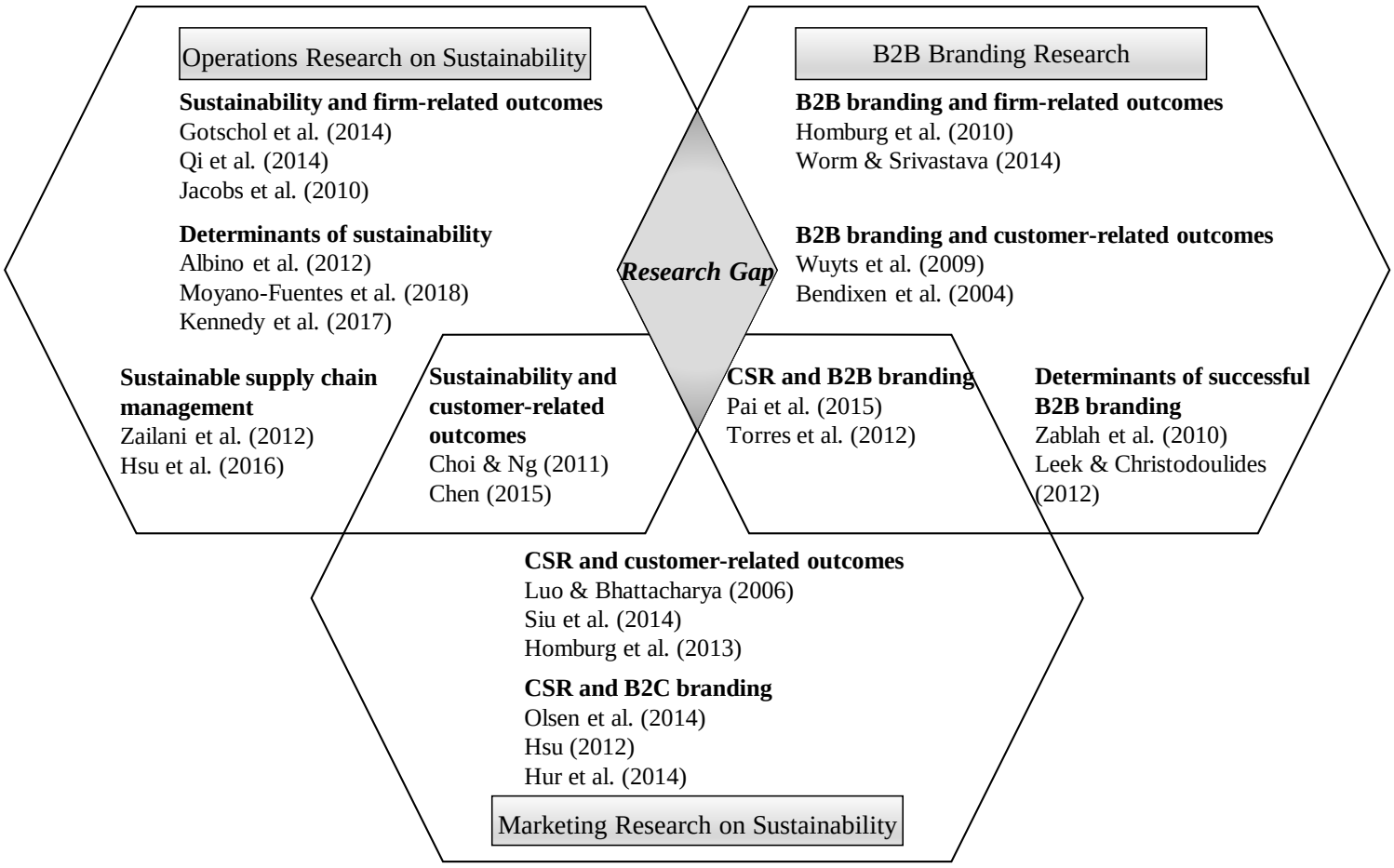
pursue sustainability by focusing on inter-organizational collaboration (e.g., Albino, Dangelico, & Pontrandolfo, 2012), organizational innovation (e.g., Moyano-Fuentes, Maqueira-Marín, & Bruque-Cámara, 2018), and sustainable supply chain management (e.g., Hsu, Tan, & Zailani, 2016). Another domain of work within operations research on sustainability includes sustainability practices as a part of the overall operations strategy to improve outcomes at the firm level such as profitability and market share (e.g., Gotschol et al., 2014; Jacobs, Singhal, & Subramanian, 2010).

In contrast, marketing research on sustainability has largely been related to either corporate social responsibility (CSR) or green marketing. This domain of research shows that firms integrate sustainability into their business strategies in an effort to influence customer and branding-related outcomes. The focus of these works includes customer satisfaction (Luo & Bhattacharya, 2006), customer loyalty (Homburg et al., 2013), customer-firm identification (Siu, Zhang, & Kwan, 2014), and brand equity in the context of B2C (Olsen et al., 2014; Hsu, 2012). Interestingly, the small body of research addressing the connection between sustainability and branding has focused on the B2C context, whereas branding consequences of sustainability in the B2B context has remained unobserved. Only more recently have marketing researchers begun to explicitly examine the link between CSR and B2B branding (e.g., Pai, Lai, Chiu, & Yang, 2015; Torres, Bijmolt, Tribó, & Verhoef, 2012). Interestingly, this domain of research has not considered the core nature of sustainability in terms of efficient consumption of natural resources and environmental remediation.

Furthermore, empirical research on B2B branding has mainly focused on identifying the implications of B2B brands for organizational buying decisions (e.g., Wuyts et al., 2009; Bendixen, Bukasa, & Abratt, 2004) or firm performance (e.g., Homburg et al., 2010; Worm & Srivastava, 2014). However, reviewing the research on B2B branding indicates that despite the recognized importance of branding in business markets (Zablah et al., 2010), much of the work

investigating the salient drivers of brand equity in B2B markets remains conceptual or anecdotal (e.g., Leek & Christodoulides, 2012).

Figure 3.2 Overview of empirical research



As shown in the overlapping areas of Figure 3.2, there has been empirical research that bridges the three research domains. However, the intersection of the three research domains shows marketing research examining firms' sustainability-oriented operations to promote their brands in the B2B context is scarce. Therefore, given the importance of branding and pressure on firms to undertake sustainability practices we address the intersection of these two important challenges for B2B manufacturing firms. To unlock the interplay and examine potential benefits and drawback, we draw on signaling theory to examine the potential of B2B firms improving their brand images through sustainability. We focus on brand image as it plays a

vital role in increasing the probability of brand choice, customer loyalty, perceived quality, and distinguishing the firm from competitors (Schnittka, Sattler, & Zenker, 2012; Yoganathan, Jebarajakirthy, & Thaichon, 2015; Cretu & Brodie, 2007).

Signaling theory implies that signals like a firm's values or brand can serve as cues to the firm's attributes or quality of its products that might be unknown to customers prior to purchase (Brach et al., 2018; Sharma et al., 2016). By signaling certain characteristics hidden from stakeholders, a firm can distinguish itself from other potential market participants (Ruhnke & Gabriel, 2013). Signals can distinguish the firm in the market if they are costly (or difficult) to imitate by competitors and provide added value for customers (Connelly, Ketchen, & Slater, 2011).

Prior research shows that signaling theory may be informative for understanding organizational activities with respect to sustainability (e.g., Connelly et al., 2011; Kuzey & Uyar, 2017). Although it is often difficult for customers to evaluate the extent to which a firm pursues sustainability practices (Connelly et al., 2011; Hahn & Kühnen, 2013). However, this is less of an issue in B2B markets due to the close relationships between firms and business customers enabling customers to actively monitor firms' performance and measure it against their expectations (Cannon & Perreault, 1999; Narayandas & Rangan, 2004). Accordingly, when B2B manufacturers invest in sustainability practices such as efficient resource consumption and pollution reduction, they send observable and sought-after signals to their partners in the supply chain about their commitment and respect of the environment and natural resources (Connelly et al., 2011; Ruhnke & Gabriel, 2013).

3.2.1 Sustainability and brand image

Brand image is the mental picture that customers hold about a firm (Brown, Dacin, Pratt, & Whetten, 2006) and is seen as a set of information connected to a brand in the minds of

customers (Keller, 1993). The images conveyed create a unique position of the firm in the customer's mind which separates the firm from others in its industry (Campbell, Papania, Parent, & Cyr, 2010). Brown et al. (2006) consider the positioning of a firm through brand image as "one of the most important strategic-level decisions that corporate managers make" (pp. 103).

Prior research suggests that by adopting sustainability practices, a firm may signal its customers projecting its commitment to the environment and thus establishing an environmentally friendly image (Lai, Wong, & Lam, 2015). Similarly, Blenkhorn and MacKenzie (2017) in categorizing sustainability practices for B2B firms, believe that a firm can improve its reputation and brand equity by effective communication of its sustainability practices to its stakeholders. This indicates firms can maximize their brand image by leveraging or engraining their image in sustainability.

Accordingly, from a signaling perspective it is expected that sustainability acts as a differentiator or leverage to foster or improve brand image for two main reasons. First, in the context of B2B, customers are accustomed to having a close relationship with manufacturing firms which is evident in long-term contracts between parties (Kearney, Walsh, Barnett, Gong, Schwabe, & Ifie, 2017; Stock & Zacharias, 2013). Close and long-term relationship between the customer and firm enable customers to more accurately foretell a firm's actions, a rational mechanism that addresses customers' psychological need for belongingness (Homburg et al. 2013). Given that customers look for satisfactory reasons to be associated with a brand (Gupta, Czinkota, & Melewar, 2013), they can recognize once a firm undertakes sustainability practices. Understanding potential suppliers' sustainability practices motivates customers to differentiate between brands according to sustainability-based actions, where undertaking sustainability fosters a positive reputation.

Second, there are situations where a firm may fail to establish close relationships with its business customers. These situations may set the scene for "greenwashing", wherein customers perceive that the signals originate in firms who engage in deceptive sustainability efforts (Gershoff & Frels, 2015; Olsen et al., 2014). This is especially so with a degree of cynicism and distrust when the firm's marketers report on its sustainability practices (Blenkhorn & MacKenzie, 2017). However, even accounting for the negative aspects, the B2B literature suggests that a firm may signal its commitment to the environment and the community in which it operates to increase its customers' trust (Homburg et al., 2013). In a similar vein, activities such as proactive environmental practices and pollution abatement are argued to be able to create a reputation that a firm is reliable and honest, and is benevolent, and has integrity, and trustworthiness (McWilliams & Siegel, 2001; Bhattacharya, Korschun, & Sen, 2009). Thus, in line with reasoning found in the literature, we similarly postulate that from a customer's perspective, sustainability practices are more likely to serve as a signal to convey trustworthiness and credibility of the firm and its brand(s). Consequently, in considering trust, credibility as well as reputation that underlie brand image and the global push for improved sustainability, we suggest,

H1: Sustainability practices positively affect a manufacturers' brand image as perceived by business customers.

3.2.2 Moderating role of CRM

While we acknowledge the inextricable connection between sustainability and brand image there are factors that may attenuate this relationship (effect), especially how well a firm manages its relationships with customers. This is especially for relationships in B2B settings where relationships as discussed above have very unique and powerful roles. The underlying assumption in CRM is that firms view customers as manageable strategic assets (Reimann,

Schilke, & Thomas, 2010). Moving beyond the simple practice of managing customers as strategic assets, CRM has been generally dissected into two key issues that firms must acknowledge. First, firms need to understand that relationships with customers are more than a series of discrete transactions with a relationship-level view to generate profitable outcomes for firms along with greater satisfaction for customers (Morgan, Slotegraaf, & Vorhies, 2009). Second, firms need to recognize that not all existing and prospective customers are equally attractive from the perspective of a firm's ability to profitably satisfy customers' needs and requirements (Niraj, Gupta, & Narasimhan, 2001). Building on this view, we adopt Morgan et al.'s (2009) definition of CRM which refers to a firm's ability to identify attractive customers and prospects, initiate and maintain relationships with attractive customers, and leverage these relationships into customer level profits.

Business customers who are concerned about environmental issues, vigilantly scan the environment for signals and information about firms who engage in sustainability activities. Yet, due to degrees of information asymmetry in business relationships (Stein, Smith, & Lancioni, 2013) some of the information in the market might not be visible enough to clearly and consistently communicate a firm's sustainability activities to its current and potential business customers. However, through successful implementation of CRM, the firm would be able to identify and target attractive customers and establish a dialogue with them to reduce information asymmetry (i.e., customers' lack of information about the firm's sustainability practices) and corresponding uncertainty about its operations (Stein et al., 2013). Further, CRM capability allows the firm to develop close and long-term relationships with customers (Hendricks, Singhal, & Stratman, 2007) which is a vital ingredient in B2B markets. Through close, quality relationships, a firm can send more observable and noticeable signal to customers about its sustainability activities.

In effect, signaling theory provides a meaningful grounding in B2B context. The use of appropriate signals by the firm (i.e., brand) supported by effective CRM practices help build strong relationships between the firm (brand) and its customers. The clarity and relevance of signals becomes more beneficial to stakeholders through the mechanism of CRM which allows the firm to convey a more effective signal to its customers that its operations are sustainable because CRM strengthens the connection between brand and customer. We reason this to be the case because effective management of customer relationships facilitates communication back and forward and allows the firm and its customers to closely work together and exchange vital information more freely and clearly. Therefore, we argue that a firm's adroit use of CRM can enhance business customers' awareness about its adoption of sustainability practices and help to foster a favorable image, suggesting that,

H2: The use of CRM by a firm strengthens the positive relationship between sustainability practices and brand image.

3.2.3 Moderating role of customers' attitudes toward sustainability

In this study, the impact of customers' attitudes toward sustainability are also considered as key in attenuating the relationship between a firm's sustainability practices and its brand image. According to Ajzen (1991), attitude toward a particular behavior gauges a person's evaluation of that behavior and arises from beliefs about the consequences from its performance. We define customers' attitudes toward sustainability as the degree to which customers have a favorable or unfavorable evaluation of sustainability.

Customers' attitudes toward sustainability has been emphasized as a vital determinant of their sustainability intentions (e.g., Collins, Steg, & Koning, 2007; Pickett-Baker & Ozaki, 2008). For example, Jaiswal and Kant (2018) note customers with favorable attitudes toward sustainability prefer to make more environmentally friendly purchases. In close working

relationships which is common in B2B markets, customers are more likely to compare their own characteristics with supplier firms' characteristics (i.e., brand and its image) and maintain/adjust their decisions toward their relationships with supplier firms on the basis of commonality or match (congruency). It has been acknowledged that business customers look for firms with similar mindsets to better meet their requirements (Wadhwa, Saxena, & Chan, 2008). Therefore, when business customers appreciate sustainability as a set of values, they may try to find a firm that has the same values in its business activities. As such, if the congruency between business customers' values and the firm's values is high, business customers are more likely to integrate information about the firm as well as the values it stands for, helping customers develop a stronger image of the firm in their minds. Given that there are normally a smaller number of suppliers and customers in many B2B markets (than B2C) and close working relationships between them, when the supplier firm performs well in regards to sustainability, it is more likely that its reputation improves in the market. Thus, the supplier firm will enjoy a stronger and favorable brand image in the market place, suggesting that,

H3: Customers' attitudes toward sustainability strengthen the positive relationship between suppliers' sustainability practices and their brand image.

3.2.4 Brand image and market performance

In the brand management literature, a key premise is that a favorable, strong, and unique brand image enables a firm to obtain a strong market position that, in turn, enhances economic returns (Aaker, 1991; Keller, 1998; Homburg et al., 2010). For example, Merrilees, Rundle-Thiele, and Lye (2011) find evidence that in business markets, branding increases sales revenue and market share. Further, Homburg et al. (2010) show that effective B2B brands signal quality and, reduce customers' uncertainty about product quality, and perceived risk in the buying decisions. Accordingly, we expect that favorable brand image in B2B markets drives market

performance through creating values for customers such as reducing their information costs and lowering their perceived risk of purchase. When customers perceive such values from the firm, they will be encouraged to buy more and repeat their purchase.

Brand image can signal to customers unobservable organizational attributes indicating its trustworthiness, credibility, and values to the customers (Connelly et al., 2011; Kim & Hyun, 2011). The signals sent by strong brand images allow customers to understand the value the may obtain from consumption of the branded product (Kim & Hyun, 2011). In this case, a strong (favorable) brand image conveys reputation and can serve as a signal for the firm's positive characteristics. As noted by Davis, Golicic, and Marquardt (2008) if the brand is to thrive, it must convey a profound message about the firm that resonates with customers. As such, we conjecture that in the current climate where sustainability is so prominent, sustainability-based brand image is a powerful driver of market performance. We reason this to be case because B2B brand image is mainly based on the firm's most valuable assets which link the brand with customers' preferred attributes (see Aaker, 1996; Davis et al., 2008). Brand image may also reduce functional risk for business customers as they may assume that the brands that have a good image are purchased by other customers and will not result in any competitive disadvantage (Aaker, 1991). Furthermore, when customers have a favorable image of a firm's brand, they are unlikely to switch to competitors (Srivastava & Sharma, 2013). Therefore, we expect that a B2B manufacturer with a positive brand image holds a prominent market position and a strong reputation drives sales ensuring they achieve higher market performance, suggesting that,

H4: Brand image is positively related to market performance.

3.3 Methodology

3.3.1 Sample and context

The data for this research were obtained from a survey of firms operating in the manufacturing sector. We chose the manufacturing sector because firstly it is a key source of economic growth, and secondly it creates significant environmental challenges in terms of pollution and intensive use of resources (Freire, 2018; Gunasekaran & Spalanzani, 2012). Moreover, in focusing on our specific sector, we also focused on a specific country setting – Iran as one of the Next Eleven (N-11) emerging countries (Heirati & O'Cass, 2016; Wilson & Stupnytska, 2007) and part of the Middle-east and North Africa (MENA) countries. Environmental degradation and energy depletion are significant in emerging countries due to their rapid economic growth (Geng et al., 2017; Lai et al., 2014). Particularly, the heavy dependence of the Iranian manufacturing sector on fossil fuels has made the country one of the 20 countries identified as responsible for 75% of global greenhouse gases (Kakaee & Paykani, 2013; Nasiri, Khorshid-Doust, & Moghaddam, 2013).

With rapid industrialization, the significance of controlling pollution and resource depletion, along with tighter environmental laws and policies from governments, is pushing firms in emerging countries (e.g., N-11 and MENA) to adopt sustainability practices into their core business strategies (Esfahbodi et al., 2016). The N-11 countries that have a high potential of moving into the world's top-20 economies by 2025 (Martin, 2012). These countries can also act as a bridge between developed countries and developing (and underdeveloped) countries (Kvint, 2009). Therefore, as the world is pushing for brands that show higher commitment to sustainability what happens in the N-11 emerging countries can be seen as examples of, or a litmus test of what may happen for those countries coming behind them. This may show the best way to pursue sustainability in the manufacturing sector in order to create brands with strong and favorable images and compete in an increasingly competitive global market without

sacrificing the environment. Thus, our country and industry setting provide a suitable laboratory for testing our theory.

3.3.2 Sample characteristics and data collection

Over a period of two months, the research team worked to build relationships with various government departments and industry associations to gain support for the research and enhance the ability to collect data from B2B manufacturing firms and their customers across various industries. In the first phase from each manufacturing firm, we collected data from two managers - production managers and supply chain managers – using two separate surveys (labeled as survey A for production managers and B for supply chain managers). In the second phase, we collected data from key business customers (through survey C) who purchased from the participating manufacturing firms. Our dyadic data structure minimizes concerns over single source bias and strengthens our theory testing. Coded surveys were used to allow for matching the data at the firm level.

From a directory of firms provided by the Iran General Chamber of Commerce, we identified 310 firms operating in the B2B manufacturing sector. We contacted the CEOs of the firms and provided them with an overview of the research and asked for their firms' participation. We also offered participants a summary of the findings to encourage participation. If they agreed, we asked them to provide a list of production managers and supply chain managers (who we judge would have intimate knowledge about the issues being studied). Out of 310 firms, 140 firms agreed to participate and we obtained a total of 490 contacts of production managers and 450 supply chain managers. Supply chain managers were asked to answer questions focusing on their key business customers and to provide customers' contact information (contacts were provided for a total of 650 business customers). Once supply chain managers returned their completed surveys, business customers were contacted.

In collecting the data, we followed Yu, Jacobs, Salisbury, and Enns (2013) guidelines for obtaining high-quality data from participants. Before distributing the surveys, we contacted the participants through email and telephone to ensure their level of knowledge and have their initial agreement to participate. The mailed surveys were accompanied by a cover letter explaining the purpose of the research. Additional follow-up calls were made as needed to motivate participants to return surveys and clarify any ambiguities. Overall, from 140 firms we received 1004 usable surveys, which included 370 production managers (a response rate of 75.5%), 346 supply chain managers (a response rate of 76.9%), and 288 tier-one business customers (a response rate of 44.3%). The analysis of the respondents indicated that firm operating in petrochemical industry accounted for 32.7% of the participants, iron and steel 15.5%, cement 13.6%, tire and rubber 13.6%, oil and gas industry 7.3%, electronics 7.3%, and others 10%.

To test for non-response bias we compared differences between late and early responses and found no significant differences with respect to key measures at the 5 percent significance level, suggesting that non-response bias does not appear to be a major concern (O'Cass & Ngo, 2012). Since we collected data from multiple informants in each manufacturing firm, concerns regarding common method bias was minimal (Arnold, Fang, & Palmatier, 2011). Nevertheless, to assure that common method bias was minimized, participants were informed about the confidentiality of their responses (Slotegraaf & Atuahene-Gima, 2011) and that only aggregated results would be used in published research. Participants were also advised that there were no right or wrong answers to survey questions (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

3.3.3 Measures

We used existing measure drawn from the literature and only where necessary items were newly developed. In developing all three surveys, we followed the double-translation method, in which the surveys were first prepared in English and then translated into Persian and back-translated into English using independent certified translators (Slotegraaf & Atuahene-Gima, 2011). Then, a pretest of the surveys with a sample of managers in Iran was undertaken to check for readability, flow and conceptual clarity of the surveys. We asked participants to not only answer the questions but also to provide feedback about the design and wording (Zhao, Feng, & Wang, 2015). The results of the pretest led to some minor modification of the items and survey structure to improve question clarity and instructions.

Production managers responded to 11 items measuring sustainability derived from Zhu et al. (2010). Supply chain managers responded to 7 items measuring CRM derived from Morgan et al. (2009) as well as 3 items measuring market performance developed to capture the extent that supply chain department met the sales objectives set by firms over the past year. Key business customers of each firm responded to 5 items measuring brand image derived from Aaker (1996) and Sheng and Pan (2009) as well as 7 items measuring attitude toward sustainability derived from Cordano and Frieze (2000). All multi-item measures relied on five-point Likert scales.

We controlled for firm size (log number of full-time employees), firm age (log number of years in business), and length of business relationship (log number of years the customer has been dealing with the firm). We controlled for firm size because large firms may have more resources for efficient dissemination of signals regarding their sustainability practices (Lai et al., 2015). Firm age and relationship length were controlled because among the firms those that are younger and have had shorter working relationships with customers may face a liability of

newness due to a shorter track record in the market (Homburg et al., 2013; Liu, Wong, Tseng, Chang, & Phau, 2017).

3.3.4 Measurement properties

We checked the factor loadings of all items with their respective constructs, and all factor loadings were greater than the .50 threshold (Hulland, 1999), indicating the reliability of individual items. The reliability of each construct was evaluated with composite reliability. As presented in Table 3.1, all composite reliabilities ranging from .88 to .95, were above the recommended level of .70 (Nunnally, 1978), demonstrating reliability. We checked the average variance extracted (AVE) values of all constructs to assess the convergent validity and found that they exceeded the benchmark of .50, indicating acceptable convergent validity (Fornell & Larcker, 1981).

Table 3.1 Measurement items and validity assessment

Constructs and items	**Loading**
MANUFACTURING FIRMS' PERSPECTIVE	
Sustainability[a] *(CR=.95, AVE=.65)*	
Over the past year, our firm has…	
reduced air emissions.	.77
reduced waste water.	.82
reduced solid wastes.	.86
decreased consumption for hazardous/ harmful/ toxic materials.	.83
decreased frequency of environmental accidents.	.86
improved firm's environmental situation.	.76
decreased costs for materials purchasing.	.60
decreased costs for energy consumption.	.73
decreased fees for waste treatment.	.86
decreased fees for waste discharge.	.88
decreased fines for environmental accidents.	.83
CRM[b] *(CR =.90, AVE=.57)*	
Our firm focuses on…	
getting target customers to try our products.	.79
identifying and targeting attractive customers.	.85
establishing a "dialogue" with target customers.	.62
maintaining loyalty among attractive customers.	.73
maintaining positive relationships when migrating unattractive customers.	.60
focusing on meeting target customers' long-term needs to ensure repeat business.	.87

Table 3.1 Measurement items and validity assessment

Constructs and items	Loading
enhancing the quality of relationships with attractive customers.	.78
Market performance[c] *(CR =.92, AVE=.77)*	
In thinking about our sales over the past year against the objectives set by your firm …	
in relation to the objectives set (e.g., financial, growth, costs, savings), we performed …	.88
our performance shows our achievements are …	.92
examining our financial performance shows we performed …	.86
BUSINESS CUSTOMERS' PERSPECTIVE	
Attitudes towards sustainability[b] *(CR =.88, AVE=.52)*	
I personally believe…	
sustainability is not necessary to achieve high levels of environmental and economic performance (R).	.75
sustainability is an important component of a firm's management strategy.	.83
sustainability is not an important component of manufacturing management (R).	.58
sustainability should be seen as an important component of a firm's bottom line.	.70
sustainability is an ineffective management strategy (R).	.75
sustainability improvement is the most desirable waste management goal.	.68
most sustainability projects are worthwhile.	.72
Brand image[b] *(CR =.89, AVE=.62)*	
In thinking about this supplier (the manufacturing firm)…	
we trust this firm.	.77
we admire this firm.	.72
the firm is credible.	.78
this firm has a good image.	.83
this firm has a good reputation.	.84

Notes: "R" indicates reverse coding; CR= composite reliability; AVE= average variance extracted

[a]The scale format for each of these measures was 1="Not at all" and 5="Significantly".

[b]The scale format for each of these measures was 1="Strongly disagree" and 5="Strongly agree".

[c]The scale format for each of these measures was 1="Below expected" and 5="Above expected".

To establish discriminant validity, the square root of each AVE were assessed against corresponding correlation between the constructs, and all square roots of the AVE values were higher than the respective correlations (Fornell & Larcker, 1981). Further, discriminant validity is evident when the scores of individual correlations (the off-diagonal entries) are smaller than their respective reliabilities (Ngo & O'Cass, 2012). As shown in Table 3.2, no individual correlations were greater than their respective reliabilities, indicating satisfactory discriminant validity. Means, standard deviations, correlations between constructs, and square root of AVE are reported in Table 3.2. Altogether, the results show the measures possess acceptable reliability and validity.

Table 3.2 Descriptive statistics and correlations among variables

Variables	CR	M	SD	Min	Max	1	2	3	4	5	6	7	8
1. Sustainability	.95	3.16	.65	1.70	5.00	**.81**							
2. CRM	.90	3.80	.42	2.59	5.00	.16	**.75**						
3. Brand image	.89	4.00	.45	2.20	5.00	.41**	.10	**.78**					
4. Attitudes toward sustainability	.88	3.94	.53	2.29	5.00	.35**	.02	.34**	**.72**				
5. Market performance	.92	3.40	.67	1.00	4.67	.18	.10	.33**	.11	**.88**			
6. Firm size	N/A	N/A	N/A	N/A	N/A	-.02	-.06	.00	-.13	.11	N/A		
7. Firm age	N/A	N/A	N/A	N/A	N/A	.00	-.03	.02	-.12	.00	.06	N/A	
8. Length of relationship	N/A	N/A	N/A	N/A	N/A	.06	-.10	.09	.08	.02	.03	-.10	N/A

Notes: M= mean; SD= standard deviation; square root of AVE is on the diagonal.
** indicate that correlation is significant at the .01 level (two-tailed).

Because the data were obtained from multiple production and supply chain managers within each firm (we had no fewer than two production managers and two supply chain managers in each firm), respondents' individual scores on each construct were aggregated, and the mean response for each item was computed (Keller, 1986). We also used data aggregation for business customers as we obtained data from multiple customers for each firm. The index of interrater agreement score r_{wg} was computed to assess whether aggregation of multiple respondents related to the same firm was appropriate (James, Demaree, & Wolf, 1984). The r_{wg} values for all variables exceeded the cut-off value .70 (Burke, Finkelstein, & Dusig, 1999), indicating data aggregation is appropriate.

With regard to potential bias of endogeneity, prior research indicates some possible sources, such as measurement error, omitted variables, and simultaneity (Antonakis, Bendahan, Jacquart, & Lalive, 2014; Wang, Li, & Chang, 2016). We sought to minimize measurement error by collecting data from multiple informants. Further, each respondent responded to either dependent variable, or dependent variable, or moderators (see, Wong, Wong, & Boon-itt, 2013). Potential threat of endogeneity due to omitted variables was reduced by choosing relevant control variables (see, Stock, Zacharias, & Schnellbaecher, 2017). Further, according

to Antonakis et al. (2014) the issue of simultaneity presents when independent and dependent variables simultaneously affect each other. The literature supports the view that adoption of sustainability practices is a critical input to strengthen a firm's brand equity (e.g., Kumar & Christodoulopoulou, 2014; Sheth & Sinha, 2015). Therefore, we are confident that the path is from sustainability to brand image and not vice versa. As such, endogeneity did not appear to be a major concern in this research.

3.4 Results

Multiple regression analysis was performed for both direct and moderating effects. Prior to testing the hypotheses, all indicators were mean-centered to mitigate the potential problem of multicollinearity (Algina & Moulder, 2001). Further, assessment of the variance inflation factors (VIFs) revealed that the maximum VIF reached a value of 1.52, substantially below the cut-off value of 10 (Mason & Perreault, 1991), indicating no multicollinearity concerns.

To test the hypothesized relationships, we followed a stepwise approach and developed different models to test the proposed relationships in the research model (Aiken, West, & Reno, 1991). Table 3.3 presents the results of the stepwise development of the full regression analysis. In the first model, we tested the impact of three control variables (firm size, firm age, and length of relationship). The results indicate that no control variables were significantly related to brand image. In the second model, we tested H1 which proposed sustainability practices positively effect a manufacturer's brand image. The results provide support for this hypothesis (β=.62, t=6.38, ρ<.01); every one-unit increase in sustainability practices leads to a .62-unit increase in brand image.

In model 3 and 4 we tested the moderation effect of CRM and business customers' attitudes toward sustainability (H2 & H3). To test the moderation effects, we computed two interaction effects by computing two product terms. The first product term was calculated by

multiplying sustainability and CRM and the second product term was computed by multiplying sustainability and customers' attitudes toward sustainability. In model 3, we tested for the direct effect of sustainability, CRM, and customers' attitudes toward sustainability. In model 4, we added the product terms of CRM, and customers' attitudes toward sustainability to test hypotheses 2 and 3.

H2 proposed that CRM capability strengthens the positive relationship between sustainability practices and brand image. The result supports this hypothesis (β=.22, t=2.20, ρ<.05). To identify the area of significance and ensure the results of hierarchical regression modeling stand, PROCESS (Hayes 2013) and floodlight analysis proposed by Johnson and Neyman (1936) were used. Floodlight analysis is appropriate as CRM is a continuous variable (Spiller et al. 2013). The analysis revealed the moderation effect of CRM is significant for any value of CRM more than 3.68 (68.3% of values, β=.22). To test H3, the same approach to test H2 was used. H3 proposed that when customers have favorable attitudes toward sustainability the positive relationship between sustainability practices and brand image is strengthened. The result supports this hypothesis as β=.25, t=2.51, ρ<.05. The floodlight analysis revealed a significant positive effect of sustainability practices on brand image for all values of customers' attitudes toward sustainability more than 3.41 (86.5% of participants, β=.25). Using a surface plot, Figure 3.3 (A & B) visualizes the moderation effect of CRM and customers' attitudes toward sustainability on the relationship between sustainability and brand image. From an analysis of the surface plots presented in Figure 3, we note that brand image reaches its peak when both moderators (CRM and customers' attitudes toward sustainability) and sustainability reach the highest levels.

Finally, model 5 and model 6 were developed to test H4 where we proposed that brand image positively effects market performance. Model 5 reveals that no control variables were significantly related to market performance and the results in model 6 show brand image was

positively related to market performance providing support for this hypothesis (β=.30, t=2.75, ρ<.01). The results show that a one-unit increase in brand image would increase market performance by .30.

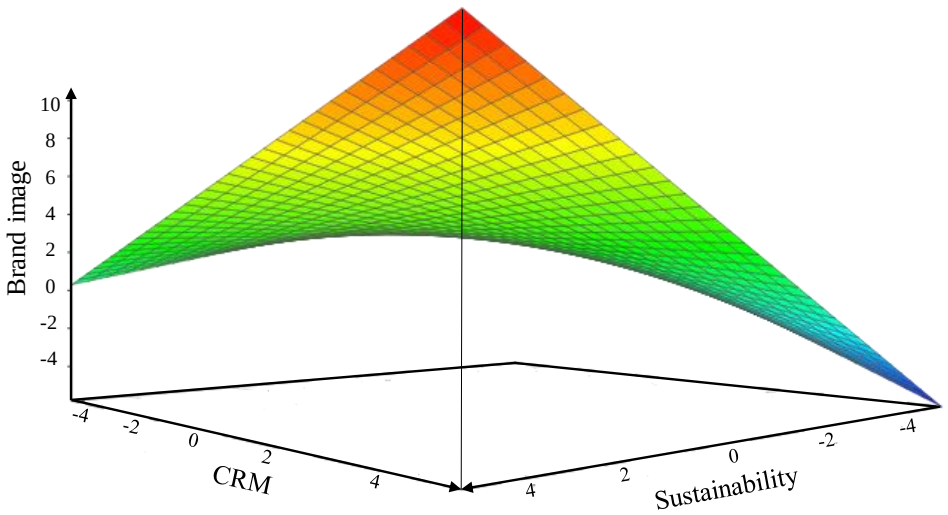
Table 3.3 Results of regression analyses

Variables	Brand image				Market performance	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Control variables						
Firm size	.01	.06	.08	.08	-.10	-.11
Firm age	-.03	.03	.05	.03	.02	.04
Length of relationship	.02	.02	.01	.00	.05	.02
Main effects						
Sustainability		.62** (6.38)	.55** (5.37)	.50** (5.10)		
Brand image						.30** (2.75)
Moderating effects						
CRM			-.10 (-1.00)	-.11 (-1.01)		
Attitudes toward sustainability			.22* (2.20)	.30** (2.75)		
Sustainability × CRM				.22* (2.20)		
Sustainability × Attitudes toward sustainability				.25* (2.51)		
R^2	.01	.38	.43	.52	.03	.13
Adjusted R^2	-.02	.35	.39	.47	.01	.08
ΔR^2		.37	.05	.09		.10

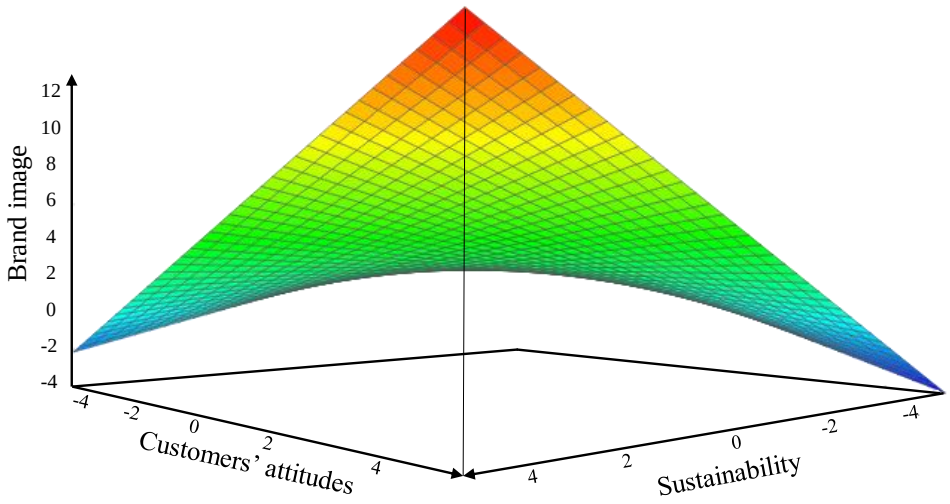
Note: * and ** indicate that correlation is significant at the 0.05 and 0.01 level; t-values are in parentheses.

Figure 3.3 The surface plots

A. The interaction between sustainability and CRM



B. The interaction between sustainability and customers' attitudes



3.5 Discussion and implications

Many emerging countries are experiencing growth in their manufacturing sectors. This is being driven by low-cost labor and material sourcing as well as flourishing markets for selling products (Rauch et al., 2016; Geng et al., 2017). Although this is resulting in economic growth in emerging countries, the downside of this phenomenon is creating challenges related to sustainability such as more pollution in the environment and increased consumption of natural resources (Esfahbodi et al., 2016). Therefore, increasing numbers of manufacturing firms in emerging countries are investing in sustainability practices in concert with more governments enacting tighter environmental restrictions to ensure that firms meet requirements for the environment in their operations (Esfahbodi et al., 2016). Although the customer-related outcomes that arise from investment in sustainability practices has been shown in prior research studying sustainability in the B2C context (e.g., Olsen et al., 2014; Chen, 2015), there is a paucity of research being conducted in the B2B contexts. This is particularly surprising as the recent literature shows that customers of B2B firms are placing greater emphasis on purchasing

brands that show higher concern for sustainability (Kumar & Christodoulopoulou, 2014, Sharma et al., 2010).

In this research, we sought to identify the extent to which a B2B manufacturing firm can pursue sustainability to improve its brand image, which can in turn, results in improvements in market performance. With our focus on sustainability and brand image, we examined the contingent roles of CRM and customers' attitudes towards sustainability. Our theoretical framework is validated through our methodology, which includes the perspectives of multiple stakeholders (i.e., B2B manufacturing firms and their customers) from different industries. The motive of the study was to offer a well-rounded understanding of the conditions under which pursuing sustainability in a B2B firm is beneficial in boosting brand image and firm performance. Our findings provide several theoretical and managerial implications.

3.5.1 Theoretical implications

This research contributes to the marketing literature by being among the first to demonstrate that sustainability is a critical input to generate a positive brand image for business customers, thus addressing a central research gap in the B2B marketing literature (Kumar & Christodoulopoulou, 2014; Sheth & Sinha, 2015). Our findings shed light on the application of signaling theory to unpack the value of sustainability in helping to build brand image and market performance of manufacturers operating in industrial markets. Existing marketing research based on signaling theory tends to focus more on the central concept of brand as a strong signal (e.g., Besharat, 2010, Sharma et al., 2016). Our findings extend the application of signaling theory in marketing, as we suggest that sustainability functions as a signaling instrument to overcome information asymmetry in the market and can effectively communicate a firm's values and creditability to its customers. This is especially important in industries where environmental issues are increasingly a high priority.

Second, our findings unpacking the contingency role of CRM adds to research that assumes a close relationship between a firm and its customers enable the firm to improve its competitive position by adopting sustainability practices (e.g., de Sousa Jabbour et al., 2017; Junquera et al., 2012). Our study takes this point in a new direction particularly in the context of sustainability and branding by showing the importance of CRM. The implications of sustainability practices become more pronounced, especially in creating a superior brand position when CRM is effective. To our knowledge this phenomenon has not received attention by marketing researchers. These findings further broaden the domain of signaling theory by showing that CRM provides a mechanism to build and manage a strong connection between a firm and its customers which allows the firm to signal (communicate) its sustainability practices to its customers to reinforce the brand's position. Therefore, theoretically we extend not only sustainability research, but also branding and CRM by highlighting the nexus between these vital theoretical domains that are increasingly relevant to marketing theory development and its application to understand major challenges facing the world.

Third, prior research has highlighted the significance of customers' environmental attitudes in their purchasing behavior and perceptions of suppliers' brands (e.g., Jaiswal & Kant, 2018; Moser, 2016). However, marketing research in the B2B environment has not investigated the extent customers' attitudes toward sustainability can further maximize the effectiveness of supplier firms' sustainability practices in enhancing their brands as perceived by their customers. In advancing this literature, our findings suggest that the extent to which firms' sustainability practices improve their brand image may depend very much on their customers' attitudes toward sustainability. Further, by integrating the manufacturer - customer dyad into our perspective, we gained a more externally valid picture of the precise customer reactions to sustainability and corresponding brand image effects and changes.

Fourth, despite growing research on B2B branding, studies are predominantly contextualized in developed countries. Our research enriches the literature which calls for research on B2B branding in emerging countries (e.g., Sheth, 2011; Wiersema, 2013), by demonstrating the importance of brand image in enhancing the market performance of firms in emerging countries (e.g., N-11 and MENA). Our findings are in line with prior research which shows the significance of branding strategies for firm performance in B2B environment (e.g., Aaker & Jacobson, 2001; Homburg et al., 2010) and now extends and validates the role of branding underpinned by sustainability in N-11 and MENA countries. Given our findings are based on a multi-informant sample collected from different industries, we believe that our research affords a more in-depth and robust appreciation, which offers more generalizable theoretical avenues for B2B branding theory, especially in emerging countries. By demonstrating the theoretical relevance of our core themes and constructs our venture into contextualizing our theory in emerging countries and highlighting key signals manufacturers can use to convey values and mission to their partners/customers advances not on sustainability theory, but also branding theory.

3.5.2 Managerial implications

Our research provides important implications for managers. Our findings suggest that a brand can become more preferable to business customers if the supplier manufacturer pursues sustainability. Thus, we urge managers in B2B markets to pursue sustainability and manage them carefully to build reputation. When this occurs, managers will need to identify and signal customers about their efforts and successes to create favorable customer perceptions. By using effective CRM, we suggest that managers need to be mindful that through their close relationships, signals become more apparent (clear) to business customers. Thus, CRM can help communicate their sustainability efforts and successes to increasingly knowledgeable and

engaged customers to facilitate better relationships grounded in a strong brand with them. Information required to drive a strong and favorable brand image can be communicated in several ways including sustainability performance reporting systems, pro-environment campaigns, B2B advertising, the salesforce and labeling products with messages to show the firm's commitment to sustainability.

In addition, managers who wish to send visible and credible signals of commitment to sustainability operations should know the value of customers with higher consciousness and positive attitudes toward sustainability. Our findings show that this will more likely manifest or not be beneficial when customers have negative or unfavorable attitudes toward sustainability. In this environment when customers do not hold favorable attitudes, pragmatic manufacturers may decide that in the long-term the benefits will outweigh the costs for engaging in positive sustainability behavior. This will actually raise the stakes in terms of the overall sustainability challenges the world (their industry) faces. We advise managers to set clear strategies aimed at reshaping those customers' attitudes in a more favorable way toward sustainability to maximize the value of sustainability investments in terms of improving their brand image and its power to enhance market performance. This may be achievable by putting in place informational campaigns or training workshops as part of their branding strategies to create an environment in which customers are encouraged to consider environmental concerns and sustainability-related challenges in their own operations. Such practices would be directed to shift customer firm's attitudes from being less positive toward sustainability to being more positive and proactive. Thus, just as B2C firms work on shifting customer attitudes, B2B manufacturing firms may also needs strategies in place to achieve this. This is important not only for firms, but also the environment which requires all parties to play their role in improving sustainability.

3.5.3 Limitations and direction for future research

Our research has several limitations that offer avenues for future research. First, we relied on a cross-sectional design, which leads to issues of causal inference. Future research may consider applying a longitudinal research design to ascertain the relationship among the variables in our model. Second, we only addressed the role of CRM and customers' attitudes toward sustainability as contingency factors affecting the relationship between sustainability practices and brand image. It is plausible that factors such as industry competitiveness and dynamism also influence the consequences of sustainability practices. Future research may investigate these factors to advance our understanding of boundary conditions that facilitate or impede the outcomes of sustainability practices. Third, our research focuses on only two key marketing assets, first brand image and second the power that brand image brings in terms of sales and market performance. We focused on brand image because we believe that manufacturing firms with a positive brand image are more likely to stand out in the market, attract new customers and retain existing customers (Hussain, Al Nasser, & Hussain, 2015). It may be interesting for future research to investigate the implications of sustainability on other marketing assets such as brand awareness, customer loyalty, customer satisfaction, customer reference, and firms' market share and sales.

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Chapter 4

Does the ambidextrous integration of suppliers and customers contribute to radical and incremental innovation?

Under review at Journal of Operations Management, ranked A* in ABDC list

Abstract

Supply chain integration, externally, with upstream suppliers and/or downstream customers, or internally, across departments, is acknowledged as a major driver of increased organizational performance. Yet, the extent to which specific forms (or combinations) of integration create additional performance effects is still unknown. This study examines how the individual and combined effects of supplier integration (SI) and customer integration (CI) generate radical and incremental innovation and thereby, impact firm performance. Relying on ambidexterity theory, we apply the concepts of balanced integration and complementary integration to advance supply chain integration theory. In addition, we address the moderating role of internal integration (II) as key to fostering the relationship between external (supplier and customer) integration and radical and incremental innovation. To test the theory, we use a triadic matched, multi-stakeholder design and match data from firms in heavy manufacturing industries to their suppliers and customers. The findings indicate that SI generates more radical than incremental innovation, while CI generates more incremental than radical innovation. The results also show that complementary integration is positively related to radical and incremental innovation, while balanced integration is unable to improve innovation. Moreover, the findings highlight the important role of II in improving the effects of SI and CI on radical and incremental innovation. Finally, the findings show that both radical and incremental innovation are differentially related to firm performance. This study provides new insights into the forms of integration that increase radical and incremental innovation.

Keywords: supply chain integration, innovation, ambidexterity, supplier, customer

4.1 Introduction

Supply chain integration (SCI), both externally (across suppliers and customers) and internally (across departments and functions), is widely accepted as having the ability to improve operational performance including quality, logistics, flexibility, new product development, and cost reduction (Flynn et al., 2010; Huo, 2012; Wong et al., 2013). Although the popularity of SCI has increased, this has not corresponded with an increased understanding of its actual effects on radical or incremental innovation within a firm (the firm sits between the upstream suppliers and downstream customers). In particular, we still lack an in-depth understanding of whether the integration of upstream suppliers and that of downstream customers are equally important and whether their individual integration effects are sufficient to improve a firm's radical and/or incremental innovation and its performance outcomes.

In addressing the simultaneous integration of suppliers and customers, we refer to the concept of ambidexterity. This is important because, within the literature, ambidextrous firms are found to be more innovative (Gibson and Birkinshaw, 2004; Jansen et al., 2006). However, research to date has paid limited attention to ambidextrous SCI (see, as the exception, Wong et al., 2013), especially in relation to innovation performance. Earlier studies describe ambidexterity as a firm's ability to simultaneously exploit existing competencies and explore new opportunities (e.g., Raisch and Birkinshaw, 2008; Tushman and O'Reilly, 1996). The works of Rothaermel and Alexandre (2009) and Wong et al. (2013) and others provide further scope for the application of this concept. The concept of ambidexterity may be particularly useful in analyzing the simultaneous integration of suppliers and customers to better understand the extent to which a firm can integrate either of these business partners to maximize specific outcomes.

In addressing supply chain ambidexterity, this study examines two specific research questions: What is the role of external and internal integration in enhancing radical and

incremental innovation? To what extent do radical and incremental innovation differentially contribute to firm performance? Answers to these questions are important because researchers and managers must understand how to manage available resources and capacity to integrate suppliers and customers into their operations to ensure they help maximize innovation and performance in their firms. However, at present, this is difficult because the majority of supply chain research, especially research focusing on SCI (e.g., Cao and Zhang, 2011; Wong et al., 2013), adopt a single stakeholder view (mainly the firm). Suppliers and customers are each likely to have an independent and different perspective of their roles in integrating with a firm. By focusing on SCI from a multi-actor (supplier-firm-customer) view in the context of each stakeholder, this study responds to calls by scholars, such as Ralston et al. (2015), and Cao and Zhang (2011), to collect data from multiple stakeholders in the supply chain context. This approach contributes to the literature by providing a more in-depth understanding of SCI. Using matched data collected from firms (production managers and logistics managers), as well as their suppliers and customers, we contribute to relational view theory (Dyer and Singh, 1998) and ambidexterity theory (Tushman and O'Reilly, 1996) in three specific ways.

The first contribution rests on the individual effects of supplier integration (SI) and customer integration (CI) on the extent the firm achieves radical and incremental innovation. Recent studies have highlighted the importance of SI and CI for product innovation (e.g., Lau et al., 2010; Wong et al., 2013), but research showing the extent that SI and CI generate both radical and incremental innovation is scarce. Further, current literature views external integration as a unified construct, combining both suppliers and customers into a single construct. This unified view towards external integration limits our understanding of the extent that integration of customers and suppliers distinctly contribute to innovation outcomes. Thus, we respond to the call by Wong et al. (2013) and Zhao et al. (2011) and examine the individual effects of SI and CI on both radical and incremental innovation. Understanding the benefits

and drawbacks of each stakeholder's contribution to enhancing radical or incremental innovation is vital to a firm's success.

Second, previous research in supply chain management has stressed the importance of SI or CI in improving innovation. However, it is still unclear whether SI and CI, when managed in an ambidextrous manner, are beneficial to innovation. Thus, to address this limitation, this study brings ambidexterity theory into the supply chain discussion and investigates the extent SI and CI work together to achieve radical and incremental innovation. Moreover, if true, what combination is more or less advantageous? Understanding the extent that SCI ambidexterity contributes to innovation may better direct a firm's attention on the stakeholder it needs to integrate more fully (or less so) to maximize innovation.

Third, researchers have recognized internal integration (II) as a crucial building block for maximizing SCI contribution to innovation performance (Wong et al., 2013; Zhao et al., 2015). However, there is limited empirical evidence addressing the contingency effect of II on the relationship between external integration and the degree of innovation. With our focus on the contingency role of II, we respond to the call by Wong et al. (2013), who believe that understanding the contributions of different actors in the supply chain is central to understanding the role of SCI in innovation and its impact. Our study extends the boundaries of current research on SCI by delving into how II works with other dimensions of SCI to support innovation activities in firms.

4.2 Theoretical model and hypotheses

The supply chain literature indicates that internal and external integration enable firms to access and leverage resources and knowledge internally and across the supply chain, which is imperative to innovation (He et al. 2014; Lau et al., 2010). While II focuses on internal

coordination, external integration addresses the coordination between a firm and its suppliers and customers across the supply chain.

Supplier (customer) integration refers to the degree to which a firm collaborates with its key suppliers (customers) to structure inter-organizational strategies, practices, procedures, and behaviors into collaborative, synchronized, and manageable processes to fulfill customer requirements (Zhao et al., 2015, p. 163). SI and CI can enhance innovation when firms across the supply chain collaborate and strategically align their business processes and share information (Lau et al., 2010). Previous studies have explored the success of SI and CI through the theoretical foundation of the resource-based view of the firm, with a specific focus on relational resources (Dyer and Singh, 1998). The relational view proposes that to achieve a competitive advantage, a firm's critical resources need to include not only its own firm-level assets (resources-capabilities), but also assets that extend beyond its boundaries and are embedded in its network of relationships with multiple parties (Cao and Zhang, 2011). The relational view focuses on the rents that are derived from relation-specific assets, knowledge-sharing routines, complementary resources, and governance mechanisms. From a theoretical viewpoint, the relational perspective explains that a firm's ability to integrate its key suppliers and customers enhances its innovation by accessing, reconfiguring, and leveraging their resources and knowledge (Ho and Lu, 2015; Ralston et al., 2015) to develop new ideas, concepts, products, and processes.

In the literature, innovation has been categorized as radical and incremental (Atuahene-Gima, 2005; Fernhaber and Patel, 2012). Radical innovation involves fundamental changes in new procedures, leading to a shift from existing products and processes to those new to the firm (Fernhaber and Patel, 2012). Conversely, incremental innovation refines and improves established procedures and represents relatively minor adaptations of existing products and processes (Fernhaber and Patel, 2012). It is now widely acknowledged that success in its many

forms requires firms to be adept at engaging in both radical and incremental innovation (Lin et al., 2013). Excessive emphasis on incremental innovation may increase a firm's risk of becoming too rigid and/or obsolescent (Raisch and Birkinshaw, 2008). Conversely, too much emphasis on radical innovation runs the risk of a success trap, where a firm fails to capture the profit from the effort and investment in the innovation (Lin et al., 2013).

The literature supports the positive effects of SI and CI on innovation. However, the combined effects of SI and CI on radical and incremental innovation are unknown. The literature highlights a tension between SI and CI regarding the espoused benefits versus potential detriments (e.g., Danese and Romano, 2011; Won Lee et al., 2007). On the one hand, SI provides interaction and synergies that enhance a firm's ability to innovate new products and processes (Lau et al., 2010). However, engaging too heavily in SI may result in disadvantages such as increasing coordination costs and greater dependencies on suppliers. These negative effects of SI increase the risk of organizational rigidity because it does not look for new resources that may come from other sources. This short sightedness impedes the firm's ability to respond effectively to customer requirements (Zhao et al., 2015). On the other hand, CI creates opportunities for enhancing the accuracy of demand information, which accelerates product design, shortens production-planning time, and reduces inventory obsolescence. These positive effects of CI allow the firm to become more efficient and responsive to current customer needs (Flynn et al., 2010). However, when the firm focuses too heavily on CI, it may fail to maximize and leverage supplier input because of the higher value given to integrating customers. The positive and negative effects of SI and CI confound managers who want to know where they should devote their (limited) resources to reap the benefits of their investments in these relationships. Focusing on the allocation of resources implies that the firm needs to find the right combination of SI and CI.

One way to address managers' concerns about resource allocation is through the concept of ambidexterity. Ambidexterity has traditionally been referred to as the ability to do two competing activities at the same time (Gibson and Birkinshaw, 2004; He and Wong, 2004). In this sense, the two activities compete for the same pool of resources (Lin et al., 2013; March, 1991). Faced with this dilemma, managers will likely favor one activity over the other, implying they will divide their attention and resources favoring one stakeholder over the other (Raisch and Birkinshaw, 2008). Recent research into ambidexterity divides it into what is referred to as a balanced dimension and a complementary dimension. The balanced dimension focuses on balancing the relative magnitude of two different activities, whereas, the complementary dimension suggests both activities should be performed at a high level to leverage their complementary effects (He and Wong, 2004). In investigating the benefits of integration with suppliers and customers, the current study unravels the combined effects of SI and CI into a balanced dimension of SI and CI (hereafter referred to as balanced integration) and a complementary dimension of SI and CI (hereafter referred to as complementary integration). Balanced integration pertains to the efforts to balance the relative magnitude of SI and CI, and complementary integration pertains to the efforts to increase SI and CI complementarities[9].

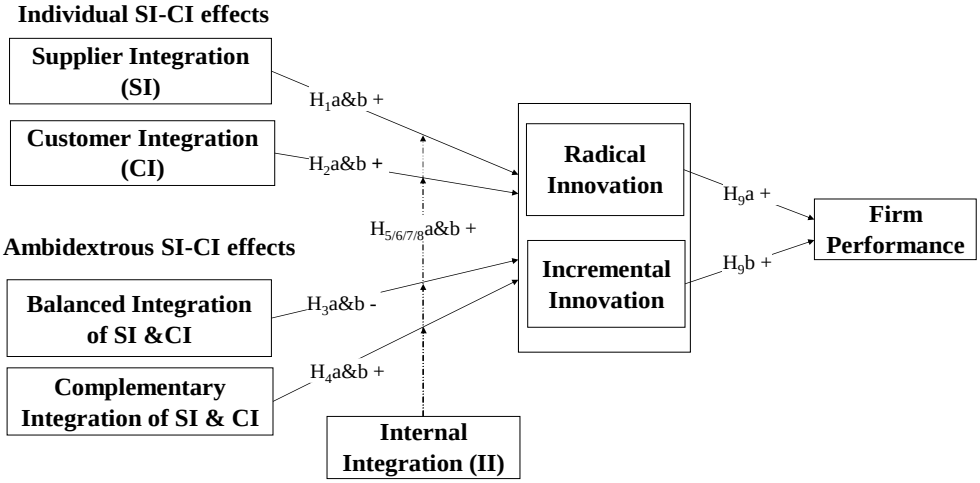
Apart from SI and CI, researchers have also highlighted the importance of II as part of the complete conceptualization of SCI (see Flynn et al., 2010; Huo, 2012; Zhao et al., 2015). II refers to the extent to which communication, coordination, and teamwork exist across functions within a firm (Dobrzykowski et al., 2016). II is often characterized by established rules, systems, and cross-functional relations, where externally sourced assets (e.g., resources and knowledge) are internally absorbed and deployed (Schoenherr and Swink, 2012; Zhao et

[9] Balanced integration occurs on a continuum ranging from low to high levels of SI and CI equally, while complementary integration does not necessarily refer to the equal level of SI and CI, instead, it focuses a higher level of each individually.

al., 2011). As such, a firm that has greater II should be better able to translate, transform, reuse, and exploit assets obtained via SI and CI (Schoenherr and Swink, 2012).

To articulate the theoretical focus of this study, Figure 4.1 presents the conceptual model developed to examine these hypothesized relationships.

Figure 4.1 Research framework



Note: On the hypothesized paths, "a" represents the paths to and from radical innovation and "b" represents the paths to and from incremental innovation.

4.2.1 Supplier integration and radical and incremental innovation

Suppliers have experience and expert knowledge about key components for the development of products and production processes (Lau et al., 2010). Thus, suppliers can provide feedback on the firm's product and production process development such as identifying design problems (He et al., 2014). Supplier involvement at this stage allows the firm to explore and access novel products/materials and production processes from its suppliers (He et al., 2014). These novel ideas about the integration of raw materials or the introduction of new manufacturing processes enhance radical innovation.

SI enables the firm to gain knowledge and resources to also advance existing products and production processes required for incremental innovation (Bierly et al., 2009). However, innovations stemming from SI are likely to be more radical than incremental because suppliers

need to predict the future of the market to sustain their own performance. In such a situation, suppliers may introduce the new integration of raw materials that requires the firm to develop a new process. Therefore, suppliers and the firm co-design new processes enabling the firm to use new combinations of materials that contribute to radically new products (Lau et al., 2010). Given that radical innovation incorporates a high degree of new knowledge and resources (Jansen et al., 2006), it is expected that greater SI will support higher levels of radical innovation than of incremental innovation. Therefore,

H_1: Higher supplier integration leads to higher levels of a) radical innovation than b) incremental innovation.

4.2.2 Customer integration and radical and incremental innovation

Customers are an essential external resource for innovation, providing novel ideas when they communicate their needs and requirements to the firm (He et al., 2014; Mahr et al., 2014). Further, CI reduces the high degree of uncertainty firms' face when engaging in innovation because customers keep the design team members in the firm updated on changes in their requirements (He et al., 2014). However, the benefits from CI show that customer knowledge and resources tend to emerge in innovation activities within the firm's current domain, and thus, increase the likelihood of incremental innovation (e.g., Mahr et al., 2014; Ordanini and Parasuraman, 2011; Yannopoulos et al., 2012). This may happen because customers mainly focus on their current needs and requirements. Furthermore, customers may possess creative ideas and insights that differ from the ones inside the firm (Franke et al., 2010). Integrating these novel ideas produces superior and distinctive product or process features (Mahr et al., 2014) and may increase the level of radical innovation. However, listening to customers may contribute mainly to customer-led incremental innovation and not to radical innovation because customers primarily rely on current knowledge and needs (Ordanini and Parasuraman, 2011;

Yannopoulos et al., 2012). While greater CI can generate more new ideas and accelerate the implementation of ideas (Ordanini and Parasuraman, 2011), CI is expected to induce more incremental than radical innovation. Therefore,

H_2: Higher customer integration leads to higher levels of a) incremental innovation than b) radical innovation.

4.2.3 Balanced integration and radical and incremental innovation

Referring to the notion of ambidexterity as outlined by Wong et al. (2013), we define balanced integration as the firm's achievement of equal levels of SI and CI. In this sense, the firm tries to ensure an equal level of emphasis on SI and CI. The literature alludes to problems with balanced integration. For example, although Wong et al. (2013) predict that balanced internal and external integration is positively related to innovation, they fail to find support for this hypothesis. In our view, when engaging in balanced integration a firm may try to optimize their scarce resources and devote equal attention to both suppliers and customers. Thus, the firm does not make trade-offs between SI and CI and this diminishes any potential advantage of one over the other. In balanced integration, the firm allocates resources equally between its suppliers and customers. In this setting, it can never maximize the benefits of either SI or CI. This is because the firm has finite resources, and thus, balanced integration operates like a resource equalization approach. Therefore, under certain scenarios, where the firm needs to enhance its level of radical innovation through SI or incremental innovation through CI, balanced integration, in this sense, is detrimental. Therefore,

H_3: Balanced integration has a negative relationship with a) radical innovation and b) incremental innovation.

4.2.4 Complementary integration and radical and incremental innovation

Following Wong et al. (2013), we define complementary integration as pursuing high levels of SI and CI to leverage their complementary effects for the simultaneous achievement of radical and incremental innovation. Central to complementary integration is the mutual beneficial effect of SI and CI that creates additional positive effects on radical and incremental innovation. The concept of complementary effects has been shown to be beneficial in terms of improving firm performance (Danese and Romano, 2011). Further, Swink et al. (2006) argue that integration activities are complementary, and so, can be adopted simultaneously to maximize overall impact on radical and incremental innovation.

The principle underlying the conceptualization of complementary integration is that SI and CI do not necessarily compete with or contradict each other. Therefore, a firm is able to pursue each at a higher level, or at levels as high as possible[10]. Adopting the theoretical underpinning of the complementary dimension of ambidexterity and in line with the argument that an individual/entity can simultaneously engage in conflicting tasks (Mom et al., 2009), we contend that SI and CI can support each other. Thus, the firm can use sequential attention or rhythmic pacing to shift between SI and CI.

Under certain circumstances, when customers hold a significant position in the market (e.g., because of dramatic changes in their needs or market competitiveness), the firm needs to gain more specialized knowledge and resources from customers. To maximize its advantage in such markets, the firm must drive these assets toward its suppliers who can incorporate them into their production planning and new product development to maximize their potential use. As such, when a firm is closely integrated with customers, it must transfer knowledge and resources via greater integration with suppliers and align supplier production plans to the final market demand (Danese and Romano, 2011). Additionally, through repeated adherence to

[10] When we say higher levels of SI and CI, we do not refer to their equal level, instead, we mean a higher level of each individually.

customer-driven innovation, a firm can gain a more in-depth understanding of the functionality of its existing knowledge and resources and learn how to benefit supplier-driven innovation. The key benefit of such awareness is that the firm will become better able to initiate different reconfigurations of existing knowledge and resources (i.e., novel discoveries), thereby, enhancing its radical innovation.

We further argue that there are potential risks and costs when a firm engages too heavily in CI. In such cases, the firm gives more attention to its customers and less attention to its suppliers and may fail to absorb the optimum level of supplier knowledge and assets to contribute fully to radical innovation. Similarly, by engaging too heavily in SI, disadvantages and costs, such as increases in coordination costs and organizational rigidity, are likely to accrue (Zhao et al., 2015). Organizational rigidity, developed in routines and mental models, may discourage independent thinking and hinder assimilation of knowledge and assets from suppliers, which, in turn, impedes the firm from effectively responding to environmental changes and changing customer preferences (Zhao et al., 2015). Furthermore, when SI is much greater than CI, the firm may fail to access and leverage new customer ideas and associated current requirements to enhance incremental innovation. As such, drawing on these contentions, we argue that simultaneously pursuing high levels of SI and CI and managing the trade-offs to maximize their complementarities (complementary integration) constitutes a platform for enhancing radical and incremental innovation simultaneously. Therefore,

H_4: Complementary integration is positively related to a) radical innovation and b) incremental innovation.

4.2.5 The moderating role of internal integration on individual SI and CI effects

Studies show that II fosters intra-firm goal alignment among supply chain functions (e.g., purchasing, planning, manufacturing, and logistics) through better information sharing and

cross-functional collaboration (Schoenherr and Swink, 2012; Zhao et al., 2015). While some studies (e.g., Zhao et al., 2011) have treated II as a precursor to external integration efforts, others (e.g., Sanders, 2007) have hypothesized that external integration is a driver of II. Additionally, in a recent study Wong et al. (2013) examine the ambidexterity effect of internal-external integration. Although there are different views on the relationship between internal and external integration in the literature, we posit that II moderates the effects of external integration on radical and incremental innovation.

A firm is able to integrate knowledge coming from its suppliers and customers through communications across its departments. Effective communications across the firm's departments and external sources of knowledge lead to an understanding of the new knowledge and its capability (Ritala and Hurmelinna-Laukkanen, 2013). This is especially relevant for incremental innovation because it assists the firm in exchanging its existing knowledge with its external partners to create incremental improvements to its current products and processes (Ritala and Hurmelinna-Laukkanen, 2013). In such cases, II enables the firm to effectively identify and utilize existing knowledge and competence across different functional areas (Wong et al., 2013).

Similarly, II helps the firm analyze knowledge from its suppliers and customers that might be fundamentally different, make sense of it, and then internalize it (Ritala and Hurmelinna-Laukkanen, 2013). When the firm internalizes new knowledge, it will be better positioned to develop radically new ideas or improve the current ideas that are used in radical innovation. As such, drawing on these contentions, we argue that greater II should better enable the firm to acquire knowledge from its suppliers and customers, which, in turn, will increase the likelihood that such knowledge combinations are useful in creating radical and incremental innovation. Therefore,

H_5. Higher internal integration strengthens the relationship between supplier integration and (a) radical innovation and (b) incremental innovation.

H_6. Higher internal integration strengthens the relationship between customer integration and (a) radical innovation and (b) incremental innovation.

4.2.6 The moderating role of internal integration on ambidextrous SI-CI effects

While we argued that balanced integration has a detrimental effect on radical and incremental innovation, similar to the above hypotheses, we posit that this negative effect diminishes in the presence of II. II enables a firm to exploit and coordinate internal knowledge to minimize the disadvantages caused by the equal allocation of resources to suppliers and customers. Internal communications and coordination bring attention to what the firm missed by allocating equal resources to suppliers and customers. We reason this to be the case because II enables the firm to identify and capture relevant external knowledge to maximize the value of the knowledge and resource commitments from each party (Zhao et al., 2015) that may eventually lead to the application of knowledge to create radical and incremental innovation. In this sense, II is a key contingency that helps the firm minimize the drawbacks of balanced integration. Therefore,

H_7. Higher internal integration weakens the negative relationship between balanced integration and (a) radical innovation and (b) incremental innovation.

Similarly, when the firm engages in complementary integration to maximize the effects of external integration on radical and incremental innovation, it will maximize the benefits from this activity when it is highly integrated internally. II creates a stronger foundation for extracting any opportunities coming from SI and CI to be used in innovation practices. Overall, II is expected to improve the application of valuable knowledge and resources gathered through

external integration, enabling better decisions that lead to more impactful radical and incremental innovation. Therefore,

H_8. Higher internal integration strengthens the relationship between complementary integration and (a) radical innovation and (b) incremental innovation.

4.2.7 Radical and incremental innovation and firm performance

The impact of radical and incremental innovation on firm performance has been widely acknowledged (e.g., Jansen et al., 2006; Lin et al., 2013). Radical innovation has the potential to push the technical frontiers of a firm, allowing it to enter new markets, generate greater market share, and result in substantially higher returns in the long-term (Beck et al., 2016). Radical innovation often becomes a source of long-term competitive advantage for firms, resulting in the creation of superior customer value, substantial cost reductions, and overall improvements in firm performance (Baker et al., 2014).

Incremental innovation, in contrast, is more apt to improve and extend the quality and value of existing products that satisfy current customer needs (Jansen et al., 2006). Incremental innovation is generally considered the "lifeblood of an organization" (Garcia and Calantone, 2002, p. 123) because it acts, first, as a competitive weapon in the market, and, second, streamlined procedures based on existing technology can help alert a business to threats and opportunities associated with the shift to a new technological plateau (Beck et al., 2016, p. 871). Therefore, incremental innovation ensures gradual improvements in existing products and processes, which, in turn, contribute to improved firm performance. Therefore,

H_9: Innovation in the form of a) radical innovation and b) incremental innovation are positively related to firm performance.

4.3 Methodology

4.3.1 Sample and data collection

To test the hypotheses, we collected data from different industries operating in heavy industrial manufacturing. By selecting this sector, we aimed for engineering oriented manufacturing industries, where firms have a broad variety of supply chain activities and innovation plays a critical role (Derbyshire, 2014). Furthermore, we focus on multiple industries to increase the generalizability of our findings. We chose Iran as an appropriate laboratory for this study because innovation in the country is a critical issue (Bagheri et al., 2015). Over the last three decades, Iran has placed high priority on innovation across various industries (Bagheri et al., 2015; Scaringella and Burtschell, 2017). Furthermore, Iran is one of the most industrialized Middle-Eastern economies (Heirati et al., 2013) and has been identified as one of the Next Eleven (N-11) emerging countries (Ulrich and Dulebohn, 2015). The N-11 have been identified as the next wave of emerging countries that have a high potential, along with the BRICS countries, of moving into the world's top-20 economies by 2025 (Martin, 2012).

Over a period of two months, researchers worked to build relationships with various government departments and industry associations. These efforts led to receiving help from these entities to support the study and the opportunity of collecting triadic data from three different organizational sources, making this study one of the first investigations in SCI research in this country. The data collection occurred in two phases. First, from the firms directly, and second, from their upstream suppliers and downstream customers. From each firm, we collected data on specific measures from two managers - production managers and logistics managers – using two separate surveys (survey A for production managers and survey B for logistics managers). In the second phase, we collected data from multiple key suppliers (through survey C) who sold to each of the surveyed firms, and multiple key business

customers (through survey D) who purchased from each of the surveyed firms. Our triadic data structure minimizes concerns over single source bias. Coded surveys were used to allow for the identification and matching of the data at the firm level. We specifically matched completed responses for the firms, their suppliers, and their customers.

We identified 310 manufacturing firms listed in the General Chamber of Commerce of Iran database operating in heavy industrial manufacturing. We contacted CEOs, provided them with an overview of the study, and asked for their firms' participation. If they agreed, we asked them to provide a list of production managers (who have intimate knowledge of firm innovation activities and performance) and logistics managers (who have intimate knowledge of relationships with key suppliers and customers). Out of 310 firms, 140 firms agreed to provide contact information for their production and logistics managers (contacts were provided for a total of 490 production managers and 450 logistics managers). Logistics managers were asked to answer questions focusing on their key suppliers and customers and to provide their contact information (contacts were provided for a total of 1300 suppliers and 650 customers). Once logistics managers returned their completed surveys, the identified suppliers and customers were contacted to gain their consent to participate in the study. Altogether, we received 1540 completed surveys, which included 370 production managers (a response rate of 75.5%), 346 logistics managers (a response rate of 76.9%), 536 suppliers (a response rate of 41.2%), and 288 customers (a response rate of 44.3%). The information collected from these four sources enabled us to access the major actors in the supply chain. Further, by focusing on multiple stakeholders, we reduced common method bias as each responded to different dependent and independent variables (Arnold et al., 2011).

The sample covers firms from a broad range of industries including; Petrochemical (32.7%), Iron and Steel (15.5%), Cement (13.6%), Tire and Rubber (13.6%), Oil and Gas (7.3%), Electronics (7.3%), and others (10%). We checked nonresponse bias by conducting a

t-test to compare the responding and non-responding firms along firm attributes such as firm size, ownership status, and age. All t-statistics were insignificant, which indicates minimal concerns regarding nonresponse bias.

4.3.2 Measure development

We drew on existing literature for the measures. Our four surveys were originally prepared in English and then translated into Persian and back-translated into English by independent certified translators to ensure the accuracy of translation (see Zhao et al., 2011). The surveys were then pretested using a sample of managers in Iran. We asked respondents to not only answer the surveys but also to provide feedback about the design and wording following procedures outlined by Zhao et al. (2015). Based on the pretest, minor changes were made to the surveys to improve question clarity and instructions. To alleviate possible social desirability bias, we promised confidentiality to respondents and informed them that their responses would be used only in the aggregate.

We surveyed the literature to identify valid measures, and, where necessary, adapted those measures to our study context. In the production manager survey (A), radical and incremental innovation items were drawn from the work of Lin et al. (2013), using three items for each. As part of the survey design, respondents were provided a short description of radical and incremental innovation and an example for each. In the logistics manager survey (B), SI and CI items were drawn from the work of Zhao et al. (2015), with five items for each, and based on the pretesting, an additional item about co-design was newly developed to broaden the scope of the measurement. Additionally, in survey B, II was measured via a four-item scale adapted from Dobrzykowski et al. (2016) and firm performance was measured via a four-item scale adapted from Vorhies and Morgan (2005). Unique to this study and the SCI literature (e.g., Wang et al., 2016), to gain a more in-depth appreciation of SCI, in addition to measuring

SI and CI from the firm's perspective (in survey B), we also measured SI from the perspective of suppliers (in survey C) and CI from the perspective of customers (in survey D)[11].

Since the data were collected from multiple respondents, we aggregated respondents' individual scores on each variable, and computed the mean response for each single question (Keller, 1986)[12]. We then averaged the items of SI from both the firm and the supplier sides and the items of CI from both the firm and the customer sides. To check internal consistency, we computed the inter-rater agreement score r_{wg} index (James et al., 1984) and then intra-class correlation (ICC) to examine the degree of agreement among respondents on each measure (see Lin et al., 2013). The r_{wg} values for all variables were above the cut-off value of .70, and the ICC values were greater than .60 (Schneider et al., 1998), indicating strong internal consistency.

Building on prior studies, we controlled firm age and firm size, as they have the potential to affect organizational innovation and performance (Lin et al., 2013; Wei et al., 2014). Firm age was measured by the natural logarithm of the number of years since a firm was founded and firm size was measured by the natural logarithm of the number of total full-time employees at the firm. In Table 4.1, the basic descriptive statistics and correlations of the constructs are presented.

[11] In surveys C and D, SI and CI were, respectively, measured via the same items as we used in survey B.

[12] For example, some firms had more than one production (or logistics) manager participate. Additionally, for some firms, the data were obtained from multiple suppliers or multiple customers. In such cases, respondents' individual scores in each survey were separately aggregated.

Table 4.1 Descriptive statistics and correlations among variables

Variables	M	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12
1. Radical innovation	2.82	.80	**1.00**	**5.00**	**.87**											
2. Incremental innovation	3.21	.66	1.50	5.00	.42**	**.78**										
3. Internal integration	3.58	.68	1.75	5.00	.12	.10	**.84**									
4. Firm performance	3.61	.65	1.06	5.00	.24*	.47**	.01	**.92**								
5. Supplier integration	3.91	.53	2.00	5.00	.39**	.29**	.13	.11	**.78**							
6. Customer integration	3.53	.54	1.83	5.00	.24*	.42**	.18	.17	.54**	**.81**						
7. Balanced integration	N/A	N/A	N/A	N/A	-.04	-.02	-.29*	.03	-.15	-.06	N/A					
8. Complementary integration	N/A	N/A	N/A	N/A	.35**	.18	.14	.10	.50**	.52**	.13	N/A				
9. Firm age	N/A	N/A	N/A	N/A	-.01	-.06	.10	-.09	-.06	-.08	.02	-.06	N/A			
10. Firm size	N/A	N/A	N/A	N/A	-.20	-.10	.31*	-.15	-.10	-.03	.07	.07	.36**	N/A		
11. Relationship length with supplier [a]	N/A	N/A	N/A	N/A	.13	.08	-.04	.12	.29**	.13	.11	-.14	-.07	.13	N/A	
12. Relationship length with customer [a]	N/A	N/A	N/A	N/A	.07	.15	.13	.08	.15	.33**	.08	-.12	.02	.14	.10	N/A

Notes: M= mean; SD= standard deviation; square root of AVE is on the diagonal.
*, and ** indicate that correlation is significant at the .05, .01 level respectively (two tailed).
a Variable used as instruments for the assumed endogenous variable.

4.3.3 Measure assessment

Our exploratory factor analysis for all the measures resulted in theoretically expected factor solutions (see Table 4.2). We then computed the internal consistency of our measurement items for constructs using Cronbach's alpha. As depicted in Table 4.2, the values of Cronbach's alpha were in the range of .86 to .93 for all constructs and exceeded the critical value (above .70). We also computed the values of composite reliability (CR), which were in the range of .83 to .96, and average variance explained (AVEs), which were in the range of .61 to .86. Therefore, we concluded that our constructs exhibited acceptable psychometric properties.

Next, confirmatory factor analyses (CFA) was conducted to evaluate the convergent and discriminant validity. The fit of the CFA for the study conducted was acceptable: χ^2 (284) = 455.5, RMSEA = .07, NNFI = .81, CFI = .91 and SRMR = .06 (Hu & Bentler, 1999). The standardized coefficient of each item was significant ($\rho<.01$), suggesting that all constructs achieved convergent validity. None of the confidence intervals of the correlations for the

constructs (i.e., phi values) contained a value of one, showing discriminant validity of the measures. In addition, the square root of AVE (shown in the diagonal in Table 4.1) for each construct was greater than the corresponding correlations, providing further evidence of discriminant validity (Schoenherr and Swink, 2012).

Table 4.2 Preliminary results

Constructs	Item	Loading
Radical Innovation	*Over the last three years, compared to the previous three years…*	
α=.93; CR=.90; AVE=.76	this firm frequently introduced radical new products and/or processes.	.87
	this firm introduced more radical new products and/or processes.	.88
	the percentage of new radical product and/or process innovations implemented in this firm was greater.	.87
Incremental Innovation	*Over the last three years, compared to the previous three years…*	
α=.87; CR=.83; AVE=.62	this firm frequently introduced incremental new products and/or processes.	.78
	this firm introduced more incremental new products and/or processes.	.79
	the percentage of new incremental product and/or process innovations implemented in this firm was greater.	.78
Supplier Integration	*The following statements are about your firm's relationship with your major suppliers (the focal firm)[13]…*	
α=.86; CR=.90; AVE=.61	our firm engages extensively in information exchange with these suppliers (the focal firm) through information networks.	.83
	our firm engages extensively in the establishment of quick ordering systems with these suppliers (the focal firm).	.82
	our firm engages extensively in strategic partnership with these suppliers (the focal firm).	.82
	our firm monitors the collaborative activities with these suppliers (the focal firm) in real time.	.76
	these suppliers adjust the delivery of parts or components according to our production plans (our firm adjusts production plans and product delivery according to the focal firm's demand).	.81
	our firm engages extensively in the product and process design stage with these suppliers (the focal firm).	.63
Customer Integration	*The following statements are about your firm's relationship with your major customers (the focal firm)[14]. Our firm…*	
α=.90; CR=.92; AVE=.67	engages extensively in information exchange with these customers (the focal firm) through information networks.	.83
	engages extensively in the establishment of quick ordering systems with these customers (the focal firm).	.81
	engages extensively in strategic partnership with these customers (the focal firm).	.88
	monitors the collaborative activities with these customers (the focal firm) in real time.	.81
	adjusts production plan and product delivery according to these customers' demands (the focal firm adjusts the delivery of parts or components according to our production plans).	.81
	engages extensively in the product and process design stage with these customers (the focal firm).	.76

[13] For supplier integration, bracketed wording identifies the items phrased for upstream suppliers.
[14] For customer integration, bracketed wording identifies the items phrased for downstream customers.

Table 4.2 Preliminary results

Constructs	Item	Loading
Internal Integration	*The following statements are about the internal connections between functions/departments in*	
α=.86; CR=.91; AVE=.72	*your firm. In our firm…*	
	cross-functional teams, which include production, logistics, sales and the like, are integrated for product/ or process design and improvement.	.82
	there is a high level of coordination among all functions/departments.	.90
	there is a high level of communication among all functions/departments.	.86
	information systems are integrated across all functions/departments.	.80
Firm Performance	*Over the past year, compared to the previous year…*	
α=.94; CR=.96; AVE=.86	firm's profitability has been	.93
	return on investment (ROI) has been	.92
	return on sales (ROS) has been	.95
	financial goals reached have been	.91

Note: All measures were via 1="Strongly disagree" and 5="Strongly agree" Likert scale, except for firm performance which was measured via -2 ="Much worse" and +2="Much better".

4.4 Analysis and results

We conducted hierarchical regression analysis to test our hypotheses. To mitigate the potential concern of multicollinearity, all indicators were mean-centered (Algina and Moulder, 2001). Furthermore, as multicollinearity can affect the stability of regression coefficients (Wang et al., 2016), we checked for multicollinearity in two ways. First, Table 4.1 indicates no interfactor correlations were above the .65 threshold and second, the largest variance inflation factor obtained was 1.45, substantially below the 5 cut-off, thus, multicollinearity is unlikely to bias estimates or pose any threat to the findings (Hair et al., 2011).

To test the hypothesized relationships, we followed a stepwise approach (Aiken et al., 1991). The first step featured an estimation of the direct main effects, including two control variables (firm age and firm size). After testing for the direct effects (H_1 to H_4 and H_9), we tested for moderation effects (H_5 to H_8). Each model contained a latent interaction between the independent and the respective moderator variable. A more detailed description of our procedures is provided next.

4.4.1 Results for the direct effects

First, the direct effects including control variables were estimated to assess the direct main effect hypotheses. All standardized path coefficients and their significance levels appear in Figure 4.2 and Table 4.3. H_1 predicted SI leads to higher levels of a) radical innovation than b) incremental innovation. The results show that SI is positively related to radical innovation ($\beta = .59$, $\rho<.01$) and incremental innovation ($\beta = .36$, $\rho<.01$); every one-unit increase in SI leads to a .59-unit increase in radical innovation and .36-unit increase in incremental innovation. To estimate whether the difference between the beta weights is significant, we consider the overlap between the 95% bootstrapped confidence intervals (BCI) of the two standardized beta weights (see Cumming, 2009). BCIs are calculated on 1000 resamples. If the two BCIs do not overlap or the overlap is less than 50%, the two beta weights can be considered significantly different from each other (Cumming, 2009). As can be seen in Figure 4.3 part (1), the upper bound bootstrapped 95% BCI of the incremental innovation beta weight is .49 and the lower bound bootstrapped 95% BCI of the radical innovation beta weight is .43. Since the overlap between the beta weights is less than .5, the difference between the two beta weights is significant, providing support for $H_{1a\&b}$.

H_2 hypothesized that CI leads to higher levels of a) incremental innovation than b) radical innovation. The results indicate that CI is positively related to radical innovation ($\beta = .28$, $\rho<.05$) and incremental innovation ($\beta = .50$, $\rho<.01$); every one-unit increase in CI leads to a .28-unit increase in radical innovation and .50-unit increase in incremental innovation. The same procedure is applied to test the difference between the beta weights. As shown in Figure 4.3 part (2), because the overlap between the beta weights is less than .5, the contribution of CI to incremental innovation is significantly greater than the contribution of CI to radical innovation, providing support for $H_{2a\&b}$.

Figure 4.2 Results of hypotheses testing

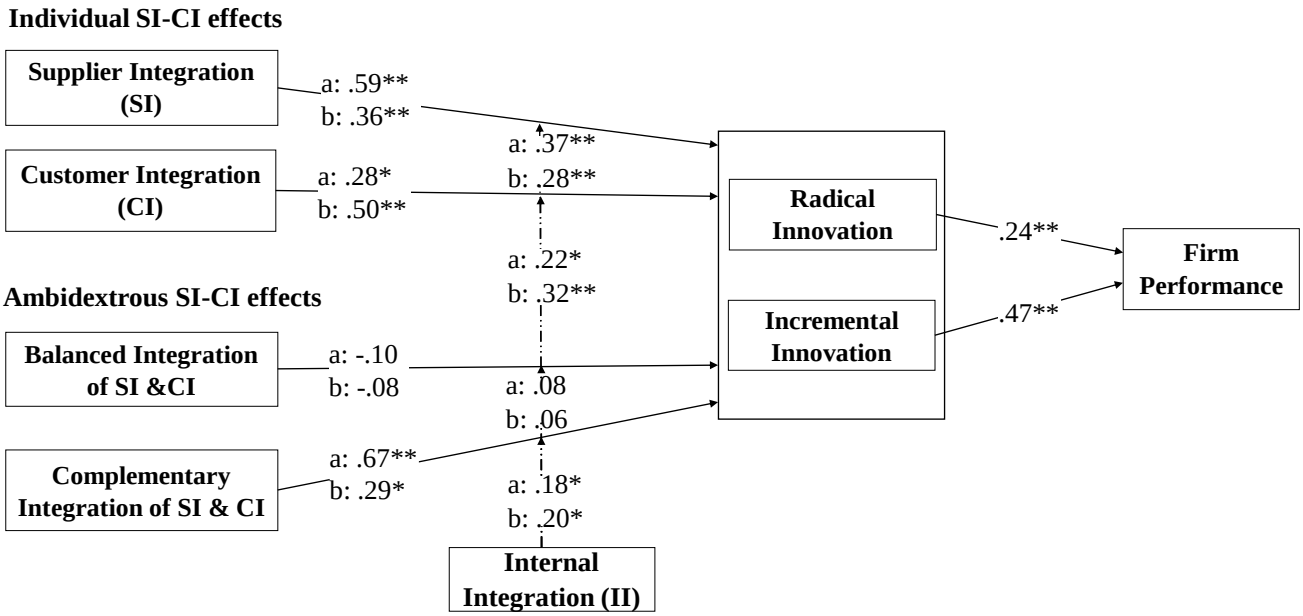
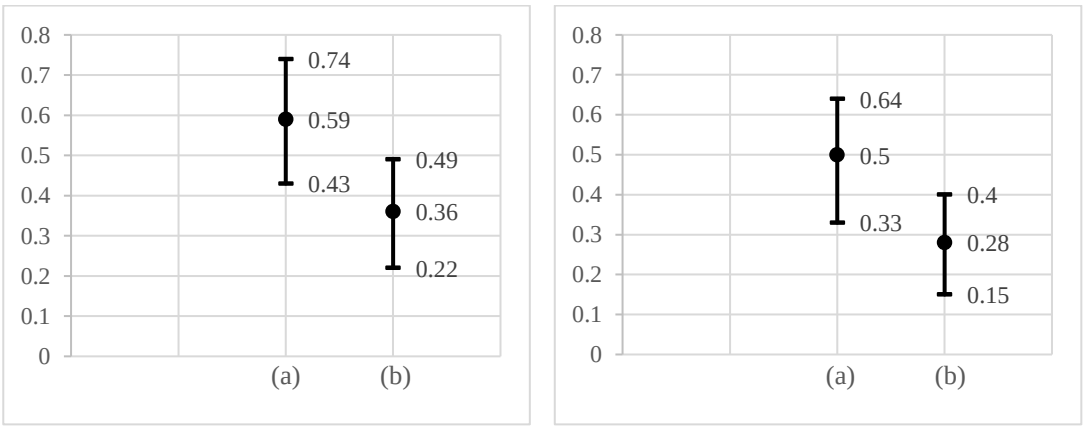


Figure 4.3 Overlap between the bootstrapped 95% BCIs of SI/CI on radical and incremental innovation



(1) **(2)**

For $H_{3a\&b}$, we hypothesized that balanced integration is negatively related to a) radical innovation and b) incremental innovation. We followed prior studies (He and Wong, 2004; Wong et al., 2013) and calculated the absolute difference between SI and CI, which was then reversed by subtracting the difference score from 5 to facilitate interpretation (see Wong et al., 2013). A higher balanced integration value indicates greater balance between SI and CI.

However, contrary to expectations, the effect of balanced integration on radical and incremental innovation was not significant, failing to support $H_{3a\&}$

For $H_{4a\&b}$, we hypothesized that complementary integration is positively related to a) radical innovation and b) incremental innovation. Complementary integration did manifest as the interaction of SI and CI, where they complement and leverage each another. Following prior studies (He and Wong, 2004; Wong et al., 2013), we created the interaction term of SI and CI to operationalize complementary integration. The results reveal that complementary integration has a positive and significant effect on radical innovation ($\beta = .67$, $\rho<.01$) and incremental innovation ($\beta = .29$, $\rho<.05$), providing support for $H_{4a\&b}$. We also conducted additional analyses to see whether the differences in effects on radical and incremental innovation are significantly different. Applying the same procedure, we consider the overlap between the 95% BCIs of the two (radical and incremental innovation) standardized beta weights. The results show approximately 50% overlap in the BCIs, and thus, the difference between radical and incremental innovation beta weights ($\Delta\beta = .38$) is not considered statistically significant. These results demonstrate that complementary integration leads to the achievement of radical and incremental innovation.

In $H_{9a\&b}$, the study also focused on the effects of radical and incremental innovation and firm performance. The analysis reveals that radical innovation significantly affects firm performance ($\beta = .24$, $\rho<.01$). The results show that a one-unit increase in radical innovation would increase firm performance by .24. Additionally, the results suggest that the level of firm performance increased with an increase in incremental innovation ($\beta = .47$, $\rho<.01$); every one-unit increase in incremental innovation leads to a .47-unit increase in firm performance. Thus, both H_{9a} and H_{9b} received support. The findings regarding the impact of control variables reveal that firm age and size are not significantly related to radical and incremental innovation or firm performance.

Table 4.3 Results

Variables	Hypotheses	Radical Innovation			Incremental Innovation			Firm Performance	
		Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2
Control variables									
Firm size		-.31	-.28	-.31	-.12	-.09	-.12	-.20	-.12
Firm age		.21	.31	.19	.04	.14	.02	.20	.16
Main effects									
SI	$H_{1a\&b}$		.59**	.58**		.36**	.37**		
CI	$H_{2a\&b}$		.28*	.30**		.50**	.51**		
Balanced integration	$H_{3a\&b}$		-.10	-.06		-.08	-.02		
Complementary integration	$H_{4a\&b}$		.67**	.65**		.29*	.28*		
II			.04	.05		.06	0.02		
Radical innovation	H_{9a}								.24**
Incremental innovation	H_{9b}								.47**
Moderating effects									
II × SI	$H_{5a\&b}$			.37**			.28**		
II × CI	$H_{6a\&b}$			.22*			.32**		
II × Balanced integration	$H_{7a\&b}$			.08			.06		
II × Complementary integration	$H_{8a\&b}$			.18*			.20*		
R^2		.04	.18	.30	.01	.19	.29	.03	.24
Adjusted R^2		.02	.15	.25	-.17	.15	.24	-.01	.20

Note: * and ** indicate that correlation is significant at the 0.05 and 0.01 level

4.4.2 Results for the moderation effects

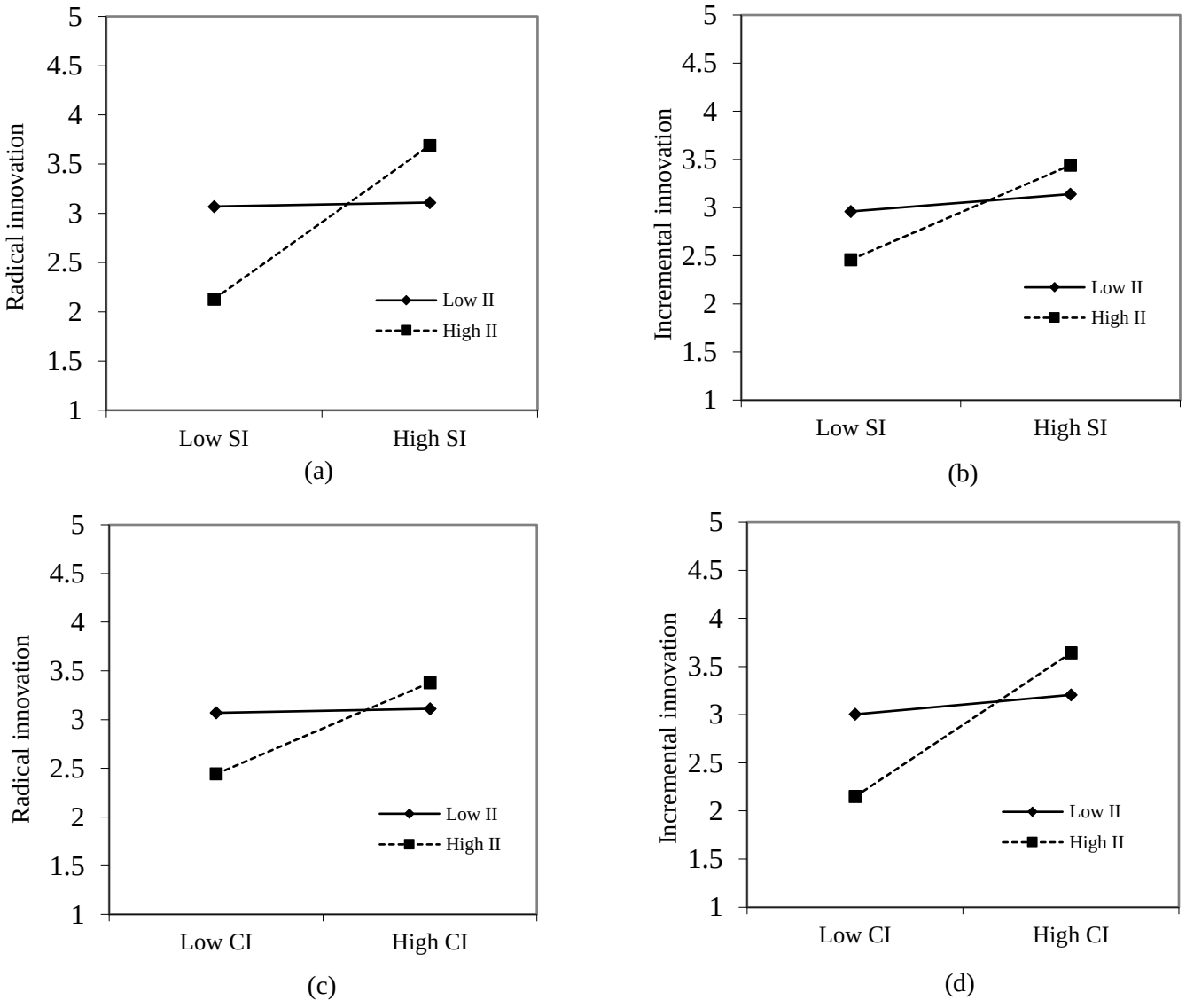
As hypothesized in $H_{5a\&b}$, the moderating effect of II on the relationships between SI and radical ($\beta = .37$, $\rho<.01$) and incremental innovation ($\beta = .28$, $\rho<.01$) are positive and significant. For $H_{6a\&b}$, we hypothesized that CI becomes more effective at higher levels of II. The results show that the effects of II on the relationships between CI and radical ($\beta = .22$; $\rho<.05$) and incremental innovation ($\beta = .32$, $\rho<.01$) are positive and significant. With $H_{7a\&b}$, it was predicted that II reverses the negative effect of balanced integration on radical and incremental innovation; however, the results reveal a non-significant effect. Finally, the effects of II on the relationships between complementary integration and radical ($\beta = .18$, $\rho<.05$) and incremental innovation ($\beta = .20$, $\rho<.05$) are in the expected direction as hypothesized in $H_{8a\&b}$.

To gain further insight into the interaction effects and evaluate the moderating effects of II, we plot the relationships in Figure 4.4, employing the steps of Aiken et al. (1991). We split

II into two groups – low (one standard deviation below the mean) and high (one standard deviation above the mean) – and estimate the effect of SI, CI, balanced integration, and complementary integration on radical and incremental innovation for both levels.

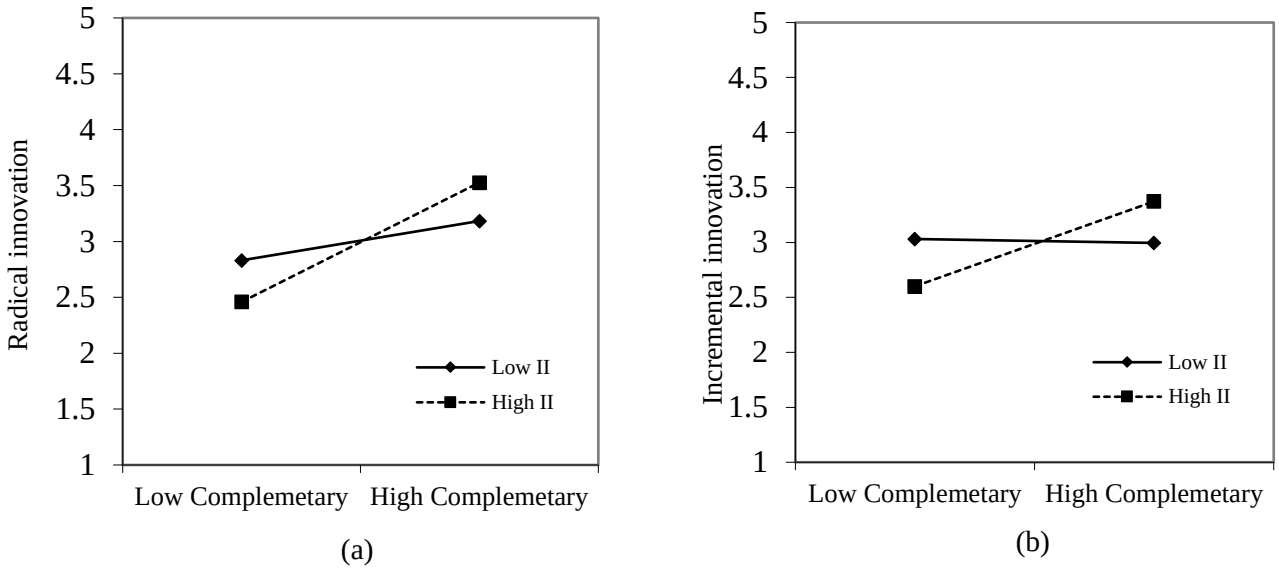
Parts (a), (b), (c), and (d) of Figure 4.4 indicate that the individual effects of SI and CI on radical and incremental innovation increase more rapidly when the level of II shifts from low to high (the slope increases).

Figure 4.4 The interaction of SI/CI levels and II levels on radical and incremental innovation



Further, to examine the moderating effect of II on complementary integration, we plot the effects of complementary integration on radical and incremental innovation for high and low conditions of II. Per Figure 4.5, parts (a) and (b) show the effect of the complementary integration on radical and incremental innovation shifts from significantly positive, when II is high, to being insignificant, when II is low.

Figure 4.5 The interaction of complementary integration and II on radical and incremental innovation



4.4.3 Endogeneity

Given that supplier and customer integration may be endogenous to their expected outcomes (e.g., Ordanini and Parasuraman, 2011; Wang et al., 2016), we controlled for endogeneity by following the procedures outlined in Wang et al. (2016). *Control for measurement error at design stage*: we minimized measurement error by collecting data from multiple stakeholders across the supply chain. We further reduced measurement error by asking respondents to respond to different dependent and independent variables included in the model (see, Arnold et al., 2011). *Decrease the possibility of simultaneous effects:* the problem of simultaneity presents when independent and dependent variables simultaneously affect each

other (Antonakis et al., 2014). The literature supports the view that the path from CI and SI to innovation outcomes and firm performance is from supplier and customer integration towards innovation and firm performance (e.g., He et al., 2014; Lau et al., 2010; Huo, 2012). We considered this view at design stage and therefore, we are confident that theoretically, simultaneity is not a concern in the study. *Using instrumental variables:* we controlled for error terms of radical and incremental innovation as well as firm performance by using supplier (customer) relationship length as instrumental variables. We measured relationship length by calculating the natural logarithm of the number of years the supplier (customer) has been dealing with the firm. Using two-stage least square (2SLS) analysis we show that relationship length with supplier is positively related to SI ($\beta = .29$, $\rho<.01$) and with customer is positively related to CI ($\beta = .33$, $\rho<.01$). The results show that the two conditions of exclusion and relevance are satisfied, and as such, endogeneity is not a threat (see, Roberts and Whited, 2012).

4.5 Discussion and implications

SCI has received increasing attention from both scholars and practitioners (He et al., 2014; Wong et al., 2013; Zhao et al., 2015). However, as the nature of SCI is complex, more research is needed to unravel its effects on innovation performance. A critical issue for managers and scholars is to understand the extent to which SI and CI, when managed ambidextrously, benefit a firm's level of radical and incremental innovation. Integrating relational view theory and ambidexterity theory, our study advances SCI literature by identifying not only the individual effects of SI and CI on innovation outcomes, but critically assessing the effects of different combinations of SI and CI on radical and incremental innovation. Further, we articulate an alternate view of the role of II in enhancing these positive effects and neutralizing negative effects of external integration on radical and incremental innovation. Our theoretical framework is supported by our methodology, including the

perspectives of multiple stakeholders across the supply chain to solve the problem of how to achieve radical and incremental innovation simultaneously along with enhanced organizational performance. Our findings contribute to practice by showing managers how a firm can enhance its radical and incremental innovation performance by managing SCI using different combinations of SI, CI, and II.

Individual effects of SI and CI. In contrast to previous studies that examine the effects of external integration on innovation performance at a general level (e.g., He et al., 2014; Lau et al., 2010; Wong et al., 2013), we explore the effects of specific combinations of external integration (SI and CI) on the degree of innovation in the form of radical and incremental innovation. We further respond to the call by Won Lee et al. (2007) and Danese and Romano (2011) and extend our focus to show that the impact of SI on radical innovation is stronger than that on incremental innovation; whereas, CI leads to greater incremental than radical innovation.

A possible explanation for this result is that suppliers may stimulate different changes consistent with their strategies in order to maintain/improve their positions (i.e., relative power in the supply chain network). As such, when a firm integrates its suppliers in the innovation process, the potential for fundamental changes (i.e., greater innovation radicalness) is likely to be greater than in the absence of such integration. In contrast, customers sometimes do not know how their needs will evolve or the impact certain products and processes will have in satisfying those needs (Cheng and Krumwiede, 2012). Therefore, customers will have the least input into radically new offerings and processes.

Complementary and balanced SI-CI and their effects. We advance the current literature by showing that SI and CI complement each other, but they do not compensate for one another when firms seek to balance their pursuit of both radical and incremental innovation. This is a unique finding as the current literature on the effects of SI and CI on innovation has failed to

clarify whether, or to what extent, SI and CI can be combined to enhance radical and incremental innovation simultaneously. The extant literature does not explain how firms manage their SCI to maximize its benefits and minimize its drawbacks in relation to the pursuit of various innovation outcomes.

Further, there is little evidence that demonstrates how to secure the benefits that accrue from managing SCI ambidextrously. This study advances the literature by providing a theoretical foundation for conceptualizing and operationalizing SI and CI in two forms, identified within the conceptualization of their combined effect, which we refer to as complementary and balanced integration, drawing on the ambidexterity literature. Such a theoretical advancement has not been offered in previous studies that examine the performance impact of each SCI dimension independently (e.g., Flynn et al., 2010) or the impact of SCI as a whole (e.g., Koçoğlu et al. 2011).

Our findings on the combined effects of SI and CI indicate that complementary integration contributes to the simultaneous achievement of radical and incremental innovation in firms. Following similar lines of thought as in ambidexterity theory, we argue that SI and CI complement one another, enabling firms to achieve specific desirable innovation outcomes and enhanced organizational performance. Essentially, our findings indicate that firms have to integrate both suppliers and customers at higher levels to maximize the benefits of SCI to achieve the highest levels of innovation performance simultaneously.

Conversely, balanced integration was found to have no significant impact on radical and incremental innovation. While we predicted, because of its nature, that balanced SCI would diminish innovation outcomes, our results did reveal a negative effect; however, this effect was not significant. This may be due to the fact that when a firm allocates equal attention to suppliers and customers, it lowers its total resource allocation to either. This decreases the

possibility of being excellent in either SI or CI, which, in turn, diminishes, to some extent, total innovation performance.

Internal boundary conditions – The moderation role of II. Previous literature indicates that II is a "crucial building block for complete SCI leading to superior firm performance" (Schoenherr and Swink, 2012, p. 100). We took the view that because of its pivotal role, II strengthens the positive impacts of the external integration setting on firm performance, particularly innovation outcomes. Interestingly, our results show II can, to some extent, compensate for the problematic effects of balanced integration on innovation. When managers devote equal emphasis to both SI and CI, they must have stronger II, which, to some extent, minimizes the poor outcomes from pursuing balanced SCI.

Another interesting finding is that incremental innovation contributes more to firm performance than radical innovation, challenging earlier assumptions of the importance of radical innovation on firm performance (e.g., Baker et al., 2014; Beck et al., 2016; Ordanini and Parasuraman, 2011). It appears that pursuing radical innovation typically requires significant development time, capital investment, and risk-taking compared with incremental innovation (Jansen et al., 2006; Lin et al., 2013). However, extensive investment in radical innovation may not pay off if the firm fails to convince customers to buy the radically new products or the newly developed processes cannot be integrated with current processes inside the firm to boost sales and profitability.

4.5.1 Managerial implications

Potentially, our study has important implications for the growing number of firms that expand their innovation activities through integration with their partners.

First, to ensure the effective development of radical and incremental innovation, firms might improve their ability to absorb external knowledge and resources via the complementary

integration of SI and CI. In other words, they might manage their efforts devoted to SI and CI depending on their desired outcome for either radical or incremental innovation, as placing emphasis on one activity complements the development of the other integration activity. If a firm wants to develop dramatically new products or processes, we suggest more emphasis be placed on integrating suppliers rather than customers. Similarly, if a firm seeks to make incremental improvements to established products, integration of customers may be more beneficial as customer knowledge and resources tend to be more related to current product and process areas.

Second, although both SI and CI are valuable assets for a firm to achieve radical and incremental innovation, for firms that suffer from scarce resources and capacity to devote attention to both suppliers and customers, before investing in it, managers need to review the specific knowledge and resource demands of the innovation project. As shown, managerial efforts to achieve balanced SI and CI can be detrimental. However, managers should emphasize the simultaneous pursuit of both SI and CI and avoid engaging too heavily in integrating only suppliers or customers.

Furthermore, to maximize the benefits of the integration with customer and suppliers, managers are advised to ensure they have well developed internal integration to enhance their opportunities to achieve the most benefit from external integration.

4.6 Conclusions and directions for future research

This study extends our understanding of how firms can leverage their supply chain to achieve radical and incremental innovation. We conceptualize the individual and combined effects of SI and CI on radical and incremental innovation. By applying ambidexterity theory, this study unravels the combined effects of SI and CI on radical and incremental innovation into balanced integration and complementary integration. We find that SI, CI, and

complementary integration are positively related to radical and incremental innovation. On the other hand, balanced integration is unable to facilitate radical and incremental innovation. Further, we investigate the moderating role of II on the individual and combined effects of SI and CI on radical and incremental innovation levels at the firm. The findings suggest a significant moderating role for II in strengthening the relationships between SI, CI and complementary integration and radical and incremental innovation.

While this study contributes to supply chain and innovation literature, there are also some specific limitations, and thus, opportunities for future research. First, innovation is successful when customer satisfaction is achieved. However, our study does not provide any explanation as to whether SI and CI can ultimately result in customer satisfaction with the innovation outcomes. Future research may advance our study by investigating the extent that integration with business partners affects customer satisfaction. Second, our study examines the effect of SCI on radical and incremental innovation. However, the literature shows challenges and costs related to integration with supply chain partners as well as environmental characteristics such as technological turbulence and competitive intensity may impact the relationship between SCI and different types of innovation. Future research may examine how the relationship between SCI and innovation changes under varying external conditions such as those above mentioned. Third, SCI is likely to develop and change over time (Zhao et al., 2015), however, this study uses cross-sectional data and does not address how changes in SCI may affect radical and incremental innovation over time. Future research may examine our model longitudinally. Fourth, we measured innovation and firm performance subjectively. Future studies may consider using objective measures of radical and incremental innovation such as turnover from introducing radical and incremental new products and processes (Beck et al., 2016). Fifth, we sampled relatively large firms with well-established supply chains. An examination of radical and incremental innovation in SMEs deserves attention, where SCI may play different roles

and require different management practices. Finally, although Iran shares many characteristics with other emerging economies, in order to determine whether our findings hold in other contexts, it is important to replicate this study in other countries, to examine cross-country differences in the relationship between SCI and radical and incremental innovation.

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Chapter 5

Discussion and conclusions

5.1 Introduction

The significance of efficient consumption of natural resources and controls for environmental pollution are continuing to trend upward, raising many challenges for manufacturing firms operating in business-to-business (B2B) markets who intensively use natural resources and cause severe harm to the environment (Sheth & Sinha, 2015). This is especially so for emerging countries where manufacturing has grown dramatically over recent years because of lower labor and raw material costs, as well as good growth prospects (Geng, Mansouri, Aktas, & Yen, 2017; Rauch, Dallasega, & Matt, 2016). With increasing awareness of the environment, growing numbers of B2B firms are recognizing sustainability as an important strategic goal, offering avenues for lowering costs and growing market share (Kumar & Christodoulopoulou, 2014; Mariadoss, Tansuhaj, & Mouri, 2011). Despite this recognition, research has remained largely silent on the factors that bolster sustainability in B2B manufacturing firms and whether investment in various sustainability practices enable them to improve their brands as a major marketing asset. Accordingly, a key motivation for this research was to examine the salient role of innovation in enhancing firms' sustainability and identify factors that support innovation. A further motivation for this research was reflecting recent calls for research focusing on the mechanisms which help B2B firms to adopt sustainability practices to create a favorable brand (Gupta, Rudd, & Lee, 2014; Kumar & Christodoulopoulou, 2014; Sheth & Sinha, 2015). In addressing these gaps, three specific research questions were posed. To answer these research questions, as outlined in Chapter 1, this thesis developed three inter-related papers. Through the three papers, the thesis not only examined the critical role of innovation in driving sustainability of manufacturing firms in emerging countries, but also identified factors that support innovation. Moreover, the thesis provided a clear understanding of the conditions under which sustainability investments in manufacturing firms operating in

emerging countries are more beneficial to boost their brand image as perceived by their business customers[15].

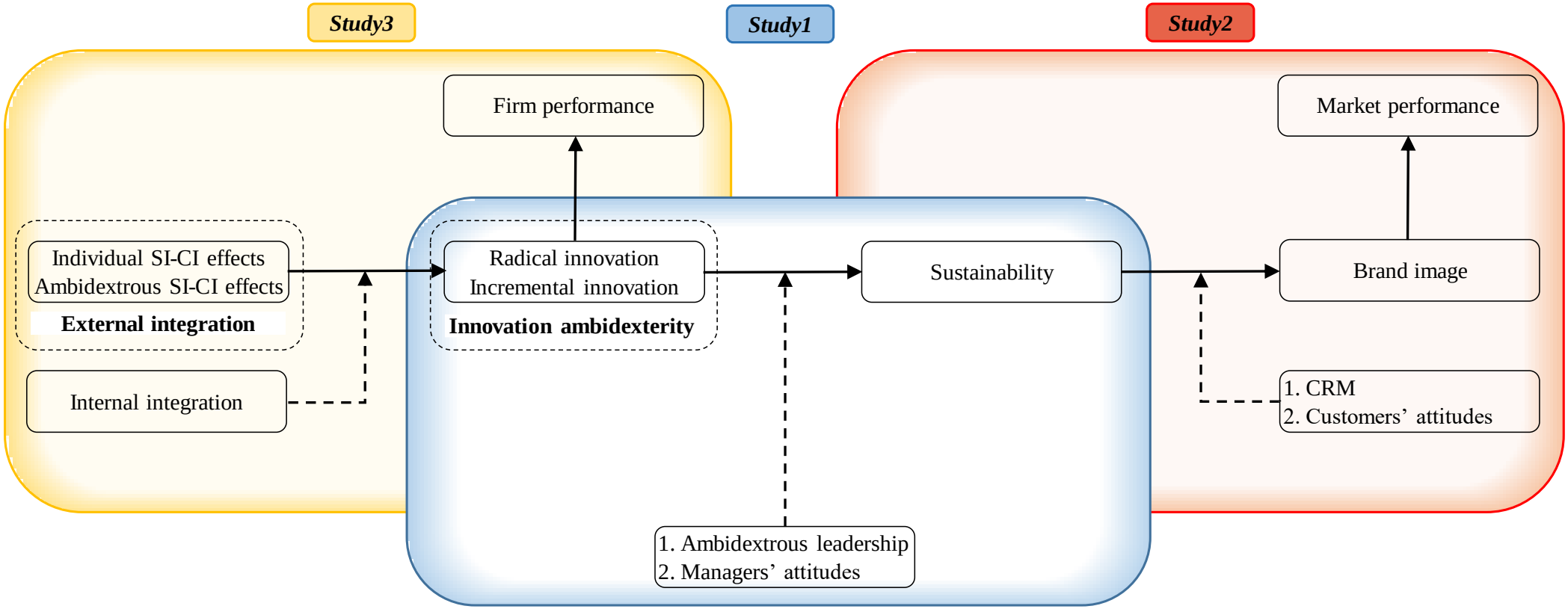
Paper 1 presented in Chapter 2, focused on the importance of innovation ambidexterity as a trigger for driving a firm's ability to pursue sustainability goals and unpacked the role that CEOs' leadership style and managers' attitudes play in supporting sustainability through organizational innovation. Paper 2 presented in Chapter 3, explored how sustainability practices contribute to strengthening brand image and whether this effect is stronger when a firm deploys customer relationship management practices and focuses on customers who possess favorable attitudes toward sustainability. Paper 3 presented in Chapter 4, uncovered the importance of internal and external integration in enhancing radical and incremental innovation, which can in turn, benefit firm performance in the long run. Finally, Chapter 5, this chapter synthesizes the findings of all three papers and outlines the theoretical and managerial contributions and the implications drawn from the findings. The closing section of this chapter is a discussion about the limitations of the research and suggestions for future research.

5.2 Synthesizing the research findings

As presented in Chapter 1, to address the shortcomings in the literature, this research sought to answer three specific research questions. To contribute to this discussion, the theoretical framework which relates to these three research questions is shown in Figure 5.1.

[15] Given the current research's focus on business customers, hereafter in Chapter 5, business customers are referred to as customers.

Figure 5.1 Sustainability in the B2B manufacturing sector: drivers and outcomes



Research Question 1 (a) To what extent does innovation ambidexterity drive sustainability? And (b) To what extent do CEOs' leadership style and business unit managers' attitudes toward sustainability elevate the impact of innovation ambidexterity on sustainability?

The study presented in Chapter 2 answers to these research questions. Drawing on organizational ambidexterity theory, the findings show that innovation ambidexterity constituted by high levels of radical and incremental innovation significantly contributes to developing sustainability practices in manufacturing firms operating in emerging countries. Interestingly, prior research has acknowledged the benefits of innovation ambidexterity in terms of improving performance across a wide range of areas (e.g., Lin, McDonough, Lin, & Lin, 2013; Tan & Liu, 2014; Zhang, Edgar, Geare, & O'Kane, 2016). However, limited attention has been given to the implications of ambidextrously managing radical and incremental innovation for sustainability. Even when this link has been considered, emphasis has been to the importance of radical innovation over incremental innovation (e.g., Keskin, Diehl, & Molenaar, 2013; Klewitz & Hansen, 2014). In advancing the literature, the findings show that the deployment of either radical or incremental innovation in isolation is not sufficient to foster sustainability and firms need to ambidextrously engage in both forms of innovation to attain higher levels of sustainability.

Furthermore, the literature has alluded to the fact that leadership styles dominant in a firm and managers' attitudes regarding the environment and sustainability are critical in implementing resource reduction activities and environmental responsiveness (Jones, Michelfelder, & Nair, 2017; Papagiannakis & Lioukas, 2012). However, no research to date appears to has investigated the contingency roles of different forms of CEOs' leadership (ambidextrous leadership) and managers' attitudes in the context of innovation and sustainability. The findings presented in this study further show that firms' whose CEOs engage in ambidextrous leadership and whose business unit managers hold favorable attitudes

toward sustainability are more likely to maximize the effect of innovation ambidexterity on sustainability. These insights contribute to a better understanding of the important role of behavioral aspects associated with CEOs' leadership style and managers' attitudes in facilitating the effect of innovation ambidexterity on business sustainability.

Research Question 2 (a) To what extent does the pursuit of sustainability improve a B2B firm's brand image? (b) To what extent does customer relationship management (CRM) help B2B firms elevate the impact of sustainability on building strong brand image? And (c) To what extent do customers with positive attitudes toward sustainability help B2B firms enhance the effect of sustainability practices on building strong brand image?

The study presented in Chapter 3 answers to these research questions. Building on signaling theory, the findings of this study demonstrate that pursuit of sustainability in B2B manufacturing firms operating in emerging countries provides a mechanism to build a favorable, strong brand image, which in turn contributes to their market performance. These findings are of significance given the state of the current literature which has to-date not investigated the role of sustainability in strengthening brand equity in the B2B context. Understanding the extent that sustainability practices enhance brand image is especially important as recent literature highlights that business customers prefer to purchase brands that demonstrate concern for the environment and sustainability (e.g., Kumar & Christodoulopoulou, 2014; Sharma, Iyer, Mehrotra, & Krishnan, 2010).

In addition, past research has indicated the benefits of relationships with supply chain partners as well as their positive attitudes toward environmental issues improve a firm's competitive position by adopting sustainability practices (e.g., de Sousa Jabbour, Vazquez-Brust, Jabbour, & Latan, 2017; Jaiswal & Kant, 2018). However, knowledge about the role of the management of customer relationships and customers' attitudes toward sustainability play

in enhancing the effect of sustainability on brand image has been limited. The findings of this study further show that CRM and possessing customers with more favorable attitudes towards sustainability are critical in strengthening the connection between sustainability practices and B2B brand image. These findings offer potential strategies for B2B marketers to better manage their customers to improve sustainability-based brand image and firm's market performance.

Research Question 3 (a) To what extent do supplier integration (SI) and customer integration (CI) individually enhance radical and incremental innovation? (b) To what extent does the combined effect of SI and CI enhance radical and incremental innovation? And (c) To what extent does internal integration foster the relationship between external integration and radical and incremental innovation?

The study presented in Chapter 4 answers to these research questions. Relying on relational view theory, the findings indicate that in manufacturing firms operating in emerging countries, SI has a stronger relationship with radical innovation than it does with incremental innovation, while CI contributes to generating more incremental innovation than radical innovation. These findings advance the supply chain and innovation literature by being among the first to explore the effects of SI and CI on the degree of innovation in the form of radical and incremental innovation. In addition, previous research focusing on the relationship between supply chain integration and innovation has failed to demonstrate the extent that simultaneous integration of suppliers and customers enhances firms' innovation outcomes. Building on organizational ambidexterity theory, this study unraveled the simultaneous effects of SI and CI into a balanced integration and a complementary integration. Balanced integration pertains to the efforts to balance the relative magnitude of SI and CI, and complementary integration pertains to the efforts to increase SI and CI complementarities. The findings of this study contribute to the literature by showing that complementary integration of SI and CI is a

meaningful path to foster radical and incremental innovation, while balanced integration has no significant impact on radical and incremental innovation.

Further, prior research has recognized internal integration as a crucial building block for maximizing supply chain integration leading to superior innovation performance (e.g., Wong, Wong, & Boon-itt, 2013; Zhao, Feng, & Wang, 2015). However, whether internal integration enhances or reduces the value of external (supplier and customer) integration in promoting radical and incremental innovation remains an unsettled question. The findings presented in this study further demonstrate that changes in internal integration contribute to changes in external integration that improve radical and incremental innovation. These findings extend the boundaries of current research on supply chain integration by uncovering the mechanisms by which internal integration works with external integration to support innovation activities in manufacturing firms operating in emerging countries.

The results of all hypothesis tested in the thesis are presented in Table 5.1.

Table 5.1 Results of regression analysis

	Hypothesis	Coefficient	Conclusion
Paper 1	innovation ambidexterity → sustainability	.35**	Supported
	innovation ambidexterity × ambidextrous leadership → sustainability	.44**	Supported
	innovation ambidexterity × managers' attitudes → sustainability	.40**	Supported
Paper 2	sustainability → brand image	.62**	Supported
	sustainability × CRM → brand image	.22*	Supported
	sustainability × customers' attitudes → brand image	.25*	Supported
	brand image → market performance	.30**	Supported
Paper 3	supplier integration → radical innovation	.59**	Supported
	supplier integration → incremental innovation	.36**	Supported
	customer integration → radical innovation	.28*	Supported
	customer integration → incremental innovation	.50**	Supported
	balanced integration → radical innovation	-.10	Not supported
	balanced integration → incremental innovation	-.08	Not supported
	complementary integration → radical innovation	.67**	Supported
	complementary integration → incremental innovation	.29*	Supported
	supplier integration × internal integration → radical innovation	.37**	Supported
	supplier integration × internal integration → incremental innovation	.28**	Supported
	customer integration × internal integration → radical innovation	.22*	Supported
	customer integration × internal integration → incremental innovation	.32**	Supported
	balanced integration × internal integration → radical innovation	.08	Supported
	balanced integration × internal integration → incremental innovation	.06	Supported
	complementary integration × internal integration → radical innovation	.18*	Supported
	complementary integration × internal integration → incremental innovation	.20*	Supported
	radical innovation → firm performance	.24**	Supported
	incremental innovation → firm performance	.47**	Supported

Note: * and ** indicate that correlation is significant at the 0.05 and 0.01 level

5.3 Implications

The findings of the studies outlined in this thesis reveal specific insights into sustainability, innovation, branding, and supply chain practices in B2B manufacturing in emerging countries which have implications for theory and practice. In view of this, the key issues elicited by the findings highlight the need for critical examination of the role of ambidextrously management of radical and incremental innovation in addressing sustainability-related challenges as well as the role of supply chain integration in driving radical and incremental innovation. The findings further underscore unpacking the mechanisms by which adopting sustainability practices help B2B manufacturing firms to build a favorable brand. Some of the more significant implications of this study that merit acknowledgment and discussion are presented in this section.

5.3.1 Theoretical implications

First, the study presented in Chapter 2 extends the scope and applicability of ambidexterity theory to the sustainability domain. The motivation for focusing on this theoretical framing is to respond to an issue raised by Maletič, Maletič, Dahlgaard, Dahlgaard-Park, and Gomišček (2014), in terms of a lack of research connecting ambidexterity to sustainability. Contrary to existing research that considers radical innovation as more effective than incremental innovation to enhance sustainability (e.g., Keskin et al., 2013; Klewitz & Hansen, 2014), this study reasons that this belief raises challenges for theory in this emerging domain. The current study theoretically argued that radical innovation creates a major breakthrough in sustainability which results from its effectiveness in establishing far-reaching changes in products and production processes. However, as argued by Rothaermel and Alexandre (2009) when a firm engages too heavily in radical innovation, it may develop uniquely distinct and novel procedures without acquiring the competencies required to identify

and exploit the technological opportunities. In contrast, the theory advanced in this study proposed that incremental innovation provides a relative improvement in environmental and economic performance of production processes compared to the current situation and ensures low-cost production process with a better environmental footprint. However, as noted by Lin et al. (2013) and Rothaermel and Alexandre (2009) a firm that engages too heavily in incremental innovation suffers from obsolescence and inertia due to technological progress. Thus, the theoretical development, supported by the findings of the current study suggest that firms that deploy both radical and incremental innovation ambidextrously will foster sustainability at a greater level than firms which only pursue one form of innovation. This insight contributes to the current debate around innovations' role in sustainability and provides a better theoretical explanation of how manufacturing firms in emerging countries go about maximizing sustainability through the effective management of their innovation activities.

Further, prior research notes that leadership plays a crucial role in strengthening the sustainability of firms (e.g., Tomšič, Bojnec, & Simčič, 2015; Maletič et al., 2014). However, at present the leadership theory has not addressed how CEOs deploying both transformational and transactional leadership provide benefits in establishing a sustainability-centered mission. This study theoretically argued that by deploying both transformational and transactional leadership (i.e., ambidextrous leadership), leaders not only envision sustainability as a vital strategy for their firms, but they also set boundaries and motivations in terms of rewards and punishments to ensure the achievement of sustainability-related goals. Therefore, the theory advanced in this study suggests that to support sustainability, leaders who engage in ambidextrous leadership behavior increase subordinates' intrinsic motivation and encourage them to adopt critical thinking that may facilitate the ability to use creative ideas. At the same time, they convey the benefits of incremental refinements to existing innovation trajectories that provide a concrete direction for subordinates to include sustainability initiatives as part of

the subordinates' routine practices. As such, it is argued that ambidextrous leaders broaden the awareness of opportunities and ideas presented by radical and incremental innovation and create an increased opportunity for tackling sustainability-related challenges. These findings add to a small body of research that indicates the benefits of leaders who are capable of deploying both transformational and transactional behaviors (e.g., Luo, Zheng, Ji, & Liang, 2016; Rosing, Frese, & Bausch, 2011). This study takes this theory in a new direction particularly in the context of innovation and sustainability and explicates how top managers, particularly CEOs of manufacturing firms operating in emerging countries improve sustainability through pursuing both radical and incremental innovation.

In addition, prior research has highlighted the significance of managerial attitudes toward the natural environment to dampen consumption of natural resources and environmental degradation (e.g., Cordano & Frieze, 2000; Papagiannakis & Lioukas, 2012). However, marketing theory has not addressed the extent that managers' favorable attitudes toward sustainability enhances the effectiveness of innovation ambidexterity in implementing resource reduction activities and environmental responsiveness. In picking up on the role of management, a key theoretical point advanced in this study was that managers with more positive attitudes toward sustainability encourage subordinates to enlarge the field of knowledge considered relevant by their firms to better address challenges related to sustainability. These managers create the opportunity to increase sustainability through motivating their subordinates to adopt ideas and opportunities presented by radical and incremental innovation that seek to improve sustainability. Thus, this study enriches theory by showing that the effect of innovation ambidexterity on sustainability is significantly improved when managers in business units hold more positive attitudes toward sustainability. This perspective is consistent with Dibrell, Craig, and Hansen (2011) that indicate top-level managers with favorable attitudes toward sustainability contribute strongly to organizational

outcomes. Our point of departure is drawing on a multi-informant dataset from cross-industry manufacturing firms in emerging countries to show more robustly that business unit managers' attitudes toward sustainability provide a mechanism which allows manufacturers to increase the number of innovative ideas that seek to improve sustainability.

Second, the study presented in Chapter 3 contributes to the marketing literature by unpacking the value of sustainability practices in building a favorable brand in the B2B setting. Although sustainability practices are being shown to help build a favorable brand in the business-to-customer (B2C) context, marketing research has paid very little attention to the role of sustainability practices in strengthening brand equity in B2B markets especially in emerging countries. This study proposed that in the context of B2B, where there is a close and long-term relationship between customers and suppliers, customers more accurately foretell suppliers' commitment to sustainability. Understanding potential suppliers' sustainability practices appears to motivate customers to differentiate between brands according to sustainability-based actions. As such building on signaling theory, it was argued that from customers' perspective, sustainability serves as a signal to convey trustworthiness and credibility of a firm that ultimately improves the business brand image. Existing research based on singling theory mainly argues that brands can serve as appropriate signals to communicate firms' characteristics (e.g., Besharat, 2010, Sharma et al., 2016). This study broadens the domain of signaling theory by showing that sustainability functions as a strong signal to convey the attributes of B2B manufacturers in emerging countries to their customers to facilitate in creating a superior brand position in the market.

In addition, it appears that perceptions and reputation of a firm, regarding sustainability, depends not only on its own operations, but may also depend on the firm's relationship with its supply chain partners (Leppelt, Foerstl, Reuter, & Hartmann, 2013; Sheth & Sinha, 2015).

Surprisingly, the sustainability literature has to date largely focused on managing relationships with suppliers (e.g., Leppelt et al., 2013; Zailani, Jeyaraman, Vengadasan, & Premkumar, 2012). There has been a distinct lack of research investigating if managing relationships with customers can enhance the effect of sustainability practices in creating a superior brand position. This study argued that successful implementation of CRM facilitates communication back and forward and allows a firm and its customers to closely work together and exchange vital information more freely and clearly. Through close relationships, the firm can send more observable and noticeable sustainability signals to its customers that can further foster or improve brand image. These findings add to previous research that notes close relationships with customers help firms to improve their competitive position from adopting sustainability activities (e.g., de Sousa Jabbour et al., 2017). This study theorized this point in a new context of sustainability and branding. This study represents a step forward to elucidate how well-managed CRM practices constitute a platform to communicate the benefits of a firm's sustainability practices to its customers to reinforce the brand and achieve stronger market performance.

Further, previous research studying B2C markets has stressed the role of customers' environmental attitudes in purchase behavior (e.g., Jaiswal & Kant, 2018; Moser, 2016). However, it is still unclear whether business customers' favorable attitudes toward sustainability enhance the positive impact of supplier firms' sustainability practices on their brands. Through close working relationships which are common in B2B markets, customers look for firms with similar mindsets to better meet their requirements (Wadhwa, Saxena, & Chan, 2008). This study raised the contention that customers with more positive attitudes toward sustainability try to find a firm with higher commitment to sustainability. Because of high congruency between customers' values and the firm's values, it appears that customers integrate more information about the firm and the values it stands for, helping customers

develop a stronger image of the firm. As such, this study extends the boundaries of current theory on sustainability and suggests customers who appreciate or value sustainability as a set of values, can further maximize the impact of sustainability practices on brand image.

Third, the study presented in Chapter 4 advances the literature on supply chain and innovation by demonstrating the impact of supply chain integration on innovation from a multi-actor (supplier-firm-customer) view. Previous research supports the positive effects of SI and CI on innovation (e.g., Lau, Tang, & Yam, 2010; Wong et al., 2013). However, supply chain literature has given little attention to the role of SI and CI on the degree of innovation in the form of radical and incremental innovation that a firm achieves. This study enriches theory by highlighting the individual effects of SI and CI on both radical and incremental innovation. This contribution to theory is important as it explains the application of relational theory by delving into how SI generates more radical innovation, while CI leads to greater incremental innovation. Additionally, the majority of supply chain integration research adopts either a single stakeholder view (mainly intermediary firms between upstream suppliers and downstream customers) (e.g., Zhao et al., 2015; Wong et al., 2013) or a dyadic view of suppliers and intermediary firms (e.g., Wagner, 2012; Wang, Li, & Chang, 2016). While this study acknowledges the significant contribution of previous researchers, it argues upstream suppliers and downstream customers may have independent effects and hold different perspectives of their roles in integrating with a firm. As such, by relying on a multi-stakeholder design and triadic matched data collected from manufacturing firms in emerging countries, as well as their suppliers and customers, this study provides much more theoretically in-depth understanding of supply chain integration and its effect on firms' innovation performance.

Furthermore, existing research based on organizational ambidexterity theory tends to focus more on the central concept of exploration and exploitation covered heavily in the

organizational learning literature (e.g., Lin et al., 2013; Zhang et al., 2016; He & Wong, 2004). Only more recently have researchers focused on trying balance the dual activities that are embedded in functional level firm activities such as responsive and proactive market orientations (Tan & Liu, 2014), service and sales (Yu, Patterson, & de Ruyter, 2013), and R&D and marketing (O'Cass, Heirati, & Ngo, 2014). The theoretical framework advanced in this study brought organizational ambidexterity theory into the supply chain domain to investigate the extent that SI and CI can be managed to work together to achieve radical and incremental innovation. Drawing on the ambidexterity literature this study conceptualized the simultaneous integration of suppliers and customers in two forms referred to as complementary and balanced integration. This theoretical framework is particularly important given the existing literature on the effects of SI and CI on innovation has failed to address the extent to which integration with both suppliers and customers benefit a firm's level of radical and incremental innovation. This study broadens the theory domain of supply chain and organizational ambidexterity theories by arguing that integrating both suppliers and customers at higher levels (i.e., complementary integration) maximizes the benefits of supply chain integration to achieve the highest levels of innovation performance. Conversely, it appears that in the context of emerging countries, when a manufacturer allocates resources equally to suppliers and customers (i.e., balanced integration), it may find it difficult to maximize the benefits from either SI or CI in facilitating radical and incremental innovation.

5.3.2 Managerial implications

The findings of the studies outlined in this thesis hold important implications for the growing number of B2B firms originating in emerging countries in general and upper-level management of B2B manufacturing firms in particular. First, the findings offer guidance to managers of manufacturing firms in emerging countries regarding the extent that the

simultaneous management of radical and incremental innovation contributes to sustainability. Business unit managers of these firms are advised to avoid falling into the 'success trap' that stifles radical innovation or a 'failure trap' that stifles incremental innovation (Gibbert, 2005). This may be achievable if upper-level management teams and especially CEOs of firms put in place education and training for managers in business units to encourage business unit managers to better understand the benefits of both radical and incremental innovation for the superior sustainability and how to manage their units to maximize both outcomes.

In unlocking the potential of innovation to support sustainability, CEOs are further advised to be mindful of considering both transformational and transactional leadership behaviors. Therefore, CEOs should be aware of their own leadership style and develop complementary leadership behaviors that match evolving business environment needs. Further, in supporting innovation-sustainability relationship, it is worth reminding top management teams about the importance of business unit managers with favorable attitudes toward sustainability. As such, a sound managerial approach would be through adopting a mechanism or a set of principles that train business unit managers about how to consider environmental concerns and sustainability-related challenges in their operations.

Second, the research findings suggest managers of B2B manufacturers operating in emerging countries, who wish to enjoy a favorable brand, to adopt sustainability practices into their operations and signal their sustainability successes to their customers. This strategy may be achievable through several actions including, but not limited to B2B advertising and promotion campaigns, sustainability performance reporting systems and putting in place pro-environment campaigns that will help them reap rewards from operating more sustainably. Specifically, managers of manufacturers of key materials such as steel, cement, and plastics are encouraged to label their products with messages to show their firms' commitment to sustainability. Managers are further advised to implement an effective CRM program to

identify and target attractive customers and establish a dialogue with them. Enacting this mechanism will help B2B manufacturing firms to convey more clear signals about their sustainability practices to their customers. Beyond putting in place CRM practices, managers must be aware of the value of customers with favorable attitudes toward sustainability. Managers who wish to send visible and credible signals of commitment to sustainability are advised to set clear strategies such as informational campaigns or training workshops to create an environment in which customers are encouraged to consider environmental concerns and sustainability-related challenges in their own operations.

Third, the findings also indicate that to provide superior radical and incremental in manufacturing firms operating in emerging countries, managers should carefully manage their suppliers and customers' knowledge and resources. In certain situations, such as when a firm needs to develop dramatically new products or processes, managers are advised to focus more on integrating suppliers rather than customers. However, when the firm needs to refine and improve the established procedures, customer integration may be more appropriate. Further, this study introduces a mechanism that managers can adopt to ensure the effective development of radical and incremental innovation at the same time. This study advises managers to emphasize the simultaneous pursuit of both SI and CI and avoid engaging too heavily in integrating only suppliers or customers. Finally, it is worth reminding managers about the importance of internal integration to profit more form integration with suppliers and customers. This suggests to managers need to develop an effective communication across different departments to maximize the consequences of external integration with respect to radical and incremental innovation.

5.4 Limitations and suggestions for future studies

Although this research provides an insightful picture of determinants of innovation and sustainability as well as the value of sustainability practices to brand success and firm performance in the B2B setting in emerging countries, the findings have specific limitations that need to be acknowledged, and which also open avenues for future studies.

First, the data for this research are cross-sectional rather than longitudinal. Although cross-sectional research leads to issues of causal inference, the common method bias does not appear to be a concern in the research. To reduce the potential threat of common method bias, this research employed multiple key participants (e.g., multiple focal firm managers, customer firm managers and supplier firm managers) who had intimate knowledge with the great expertise in the relevant topic to report on each variable (see Arnold, Fang, & Palmatier, 2011; Stock & Zacharias, 2013). Further, to assure that common method bias was minimized, participants were informed about the confidentiality of their responses (see Slotegraaf & Atuahene-Gima, 2011) and that only aggregated results would be published. Yet, clearly a cross-sectional research design does not offer the same insights into the dynamics of supply chain, innovation, sustainability, and branding as a longitudinal design. As such, it would be insightful for future research to deploy longitudinal research to empirically confirm causality and ascertain the relationship among the variables in the theoretical framework.

Second, beyond examining CRM, ambidextrous leadership, managers and customers' attitudes toward sustainability, and internal integration as moderators, other contingency factors such as technological turbulence and industry competitiveness may influence the relationships studied in this research. Future research may identify these factors to advance the understanding of boundary conditions that facilitate or impede the relationship among the variables in this study. Further, the theoretical framework of this research focuses on brand image as a major marketing asset. Brand image has been identified as a vital determinant in

retaining existing customers and attracting new ones (Hussain, Al Nasser, & Hussain, 2015). However, there are still avenues for future research to investigate the contribution that sustainability practices make to achieving other marketing assets such as brand awareness, customer loyalty, customer satisfaction, and customer reference.

Third, in operationalizing the variables, this research used subjective measures relying on managers' self-report. This approach was used because, for reasons of confidentiality, firms often refuse to provide objective data. Future research may measure some of the performance indicators in the theoretical framework by looking to access secondary data from government bodies, commercial agencies, and statistical offices. For example, radical and incremental innovation can be operationalized using turnover from introducing radical and incremental new products and processes. Also, sustainability practices can be operationalized using the amount of energy and raw material that are used in firms' production processes.

Fourth, the sample of this research is limited to manufacturing firms in a single national context, Iran, as a Next-Eleven emerging country. Although emerging countries may share common characteristics in their markets, they do also possess distinctness in terms of their economic development stages (O'Cass & Sok, 2014). In addition, the findings of this study is not deemed to be applicable to developed countries. Future research is needed to replicate, extend, or potentially challenge the findings of this research in other emerging countries or developed countries.

The limitations discussed here are to acknowledge the shortcomings of the current research and offer opportunities for future studies. Nevertheless, they do not pose a threat to the research, or render its findings less significant.

5.5 Conclusion

As many emerging countries move more rapidly into economic development, they are experiencing growth in their manufacturing sectors and consequently facing growing challenges about environmental degradation and efficient resource use. With society's growing awareness of protecting the environment and the seriousness of sustainability issues, increasing numbers of manufacturing firms in emerging countries are developing sustainability strategies in concert with host government bodies and environmental protection agencies enacting tighter environmental controls. In addressing the aforementioned challenges in emerging countries, the primary objectives of this study were exploring the convergence of innovation ambidexterity and sustainability as well as investigating how manufacturing firms in emerging countries can leverage their supply chain to achieve radical and incremental innovation. Further, this study examined the extent to which B2B manufacturers in emerging countries can pursue sustainability practices to create a favorable brand, which can in turn, improves manufacturers' market performance.

By theorizing and validating the conceptual framework outlined in Figure 5.1, this research contributes significantly to theory and practice in the areas of sustainability, innovation, branding, and supply chain. This research provides new insights into the innovation and sustainability literature and yields a better understanding about how to maximize sustainability through ambidextrously management of radical and incremental innovation. In addition, this study extends organizational ambidexterity literature into the supply chain context investigating the extent that integration with suppliers and customers can be managed to work together to facilitate radical and incremental innovation. More importantly, this study sheds more light on the extent to which adopting sustainability practices can act as a signaling instrument to improve firms' reputation and image. The findings of this study are also insightful for managers of manufacturing firms operating in emerging countries on how to catch up with

new operation trends to support sustainability and how to communicate the consequences of investment in their sustainability practices. Finally, while this study extended the understanding about the drivers and outcomes of sustainability in emerging countries, still more avenues exist for future research to pursue in endeavors to develop theory in the sustainability domain.

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Appendix – Ethics approval

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 2763
Fax: (03) 6226 7148
Katherine.Shaw@utas.edu.au

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

23 December 2015

Professor Aron O'Cass
Tasmanian School of Business and Economics
University of Tasmania

Student Researcher: Mahdi Vesal

Sent via email

Dear Professor O'Cass

Re: FULL ETHICS APPLICATION APPROVAL
Ethics Ref: **H0015411 - The role of Supply Chain Integration in improving Business Sustainability: A Study of Oil, Gas and Petrochemical Industry in Iran**

We are pleased to advise that the Tasmania Social Sciences Human Research Ethics Committee approved the above project on 23 December 2015.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

[redacted]

Katherine Shaw
Executive Officer
Tasmania Social Sciences HREC