A Dissertation

entitled

Empirical Evidence on the Use of the Balanced Scorecard and Innovation:

Exploring the Role of Firm Competences and Performance Consequences

by

Jindan Zhang

Submitted to the Graduate Faculty as partial fulfillment of the requirements for the

Doctor of Philosophy Degree in

Manufacturing and Technology Management

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An Abstract of

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The United States gross domestic expenditure on Research and Development (R&D) reached approximately $396 billion in 2013, which accounted for 2.8 % of gross domestic product (GDP) (OECD, 2015). Even though it is expensive to be innovative, organizations are more than willing to invest in innovation due to the fierce competition in the global and dynamic business world. More and more forward-thinking businesses embrace the notion of "innovate or die" (Rennekmap, 2015). This unofficial motto reflects the cruel but true fact that it is not merely preferred but required that companies be innovative to differentiate themselves from their peers in order to stay competitive. Thus, companies strive to understand the determinants of innovation and are in constant search of resources and competences needed to be innovative and successful.

Since its inception in 1992, the Balanced Scorecard (BSC) has been recognized as a key strategic management control system (Kaplan and Norton, 1992, 2001a, 2001b, 2001c). Using both financial and nonfinancial measures to evaluate firm performance in four different but related perspectives (learning and growth, internal business process, customer, and financial), the BSC has been identified as a value-creation framework

(Kaplan & Norton, 2001, 2004; Bryant et al. 2004). The BSC transforms organizations' vision into daily operations and enables the alignment of management strategy with the firm's priorities. Therefore, it is believed that the BSC leads organizations to generate and sustain its competitive advantage.

Innovation, as a major source of competitive advantage, requires various resources and competences, including superior employee skills, propriety technology, and extensive customer knowledge. Consequently, companies are under pressure to strategically link the management control systems with their vision and objectives in order to achieve the desired outcome. In this dissertation, the BSC is suggested as the management control system that provides the right focus and support needed for innovation and its integration with firms' strategies. This study investigates the effects of using the BSC on firm competences and innovation, and further examines the performance consequences of pursuing innovation.

Building on the theoretical foundation of the Resource Based View (RBV), the Knowledge Based View (KBV), the contingency theory, and the agency theory, this research develops a framework which proposes the crucial role of the BSC in promoting innovation. It is hypothesized that the relation of the BSC to innovation depends on whether the BSC can be a facilitator to competences development. The association lies in the BSC's emphasis on three competences: employee, technology, and customer. More specifically, the connection between the BSC and innovation is explained by the paths from the BSC to the three firm competences, and firm competences are hypothesized to be positively associated with innovation. Finally, since public firms are motivated to perform well financially, I hypothesize that innovation for firms that use the BSC is beneficial to firms' accounting performance and market performance.

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Following prior studies, I use a sample from the American Society for Quality (ASQ) to identify firms that use the BSC as a strategic management control system (Bryant et al., 2004). The sample includes 230 public companies (1,773 firm-year observations) across different industries from 1995 to 2015. I identify firms that use the BSC by searching keywords such as "nonfinancial" and "strategic" in the Proxy Statements from the company filings database of the United States Securities and Exchange Commission (SEC). Additionally, I collect financial information from Compustat, market information from the Center for Research in Security Prices (CRSP), and patent information from the United States Patent and Trademark Office (USPTO). Due to the use of nested data in the study, I use multilevel regression to test the relationship between the use of the BSC and innovation, and the role of firm competence in this relation. In order to address the potential endogeneity issues in the proposed positive relationship between innovation for firms that use the BSC and firm performance, I utilize Two Stage Least Squares (2 SLS) to test the last set of hypotheses using panel data identified in this study (Heij et al. 2004).

The results provide empirical evidence supporting the positive relationship between the use of the BSC and innovation. Firms that use the BSC tend to be more innovative. The results confirm the mediating role of the overall firm competences as well as the three specific competence perspectives including employee, technology, and customer in the relation between the use of the BSC and innovation. This dissertation indicates the rewarding effects of pursuing innovation using the BSC in terms of accounting and market performance in the long run. The short term effects only exist in market performance but not accounting performance. This study provides implications for both researchers and practitioners. For researchers, it offers a theoretical framework which contributes the

understanding between the use of the BSC and innovation. For managers, it provides reference for managers to follow with the objective of achieving better innovation. Moreover, it provides guidance as to how to use the strategic management control system to better organize and utilize firm resources.

To my family

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List of Abbreviations

2 SLS..........................Two Stage Least Squares

ACSI ....American Society for Quality Customer Satisfaction Index
ASQ............................American Society for Quality
ASUG.........................American SAP Users' Group

BSC ....Balanced Scorecard

CRSP..........................Center for Research in Security Prices

ERP ....Enterprise Resource Planning

GDP............................Gross Domestic Product

JIT ....Just In Time

KBV ....Knowledge Based View
KPI.............................Key Performance Indicator

MNE...........................Multinational Enterprises

RBV ....Resource Based View
R&D............................Research and Development
ROA ....Return on Assets
ROI.............................Return on Investments

PPE.............................Property Plant and Equipment
PDMA ....Product Development Management Association

SAP ....Systems Applications and Products
SEC ....Securities and Exchange Commission

TQM...........................Total Quality Management

USPTO ....United States Patent and Trademark Office

Chapter 1

Introduction

Understanding the sources of innovation for firms has become a major area of research in the field of strategic management (Betz, 2011; Danneels, 2002; Ernst, 2002; Junkunc, 2007; Roberts, 2007). Innovation is believed to be a key factor for companies to achieve competitive advantages (Prajogo, 2006). Firms are under pressure to become innovative due to the fierce competition in the business world (Chenhall et al., 2011). In developed countries, it is not merely preferred but required that companies be innovative to distinguish themselves from their competitors and to prosper in today's dynamic environment.

However, the journey to become innovative is full of difficulties, even failures if not managed appropriately. Among the difficulties are: firstly, firms may fail to recognize the need for innovation. Secondly, they may not be able to find the resources which fit strategically with innovation. Lastly, they may treat innovation as an occasional activity which ends up costing a lot but achieving a little, rather than maintaining the continuity and developing innovation advantage which brings long-term and steady benefits (Francis et al., 2003). Such challenges are even more pronounced in today's rapidly changing world where each individual customer has unique preferences and the firm's ability to satisfy

those needs depends on coordinating firm resources and competences, including skilled employees, technology know-how, and well-developed facilities.

Prior literature has argued that the use of the BSC results in thorough reflection of company's operations, then strategically linking value creation for both tangible and intangible assets, further improving firm performance both in financial benefits, such as return on assets and market returns, and nonfinancial advantages, such as manager commitment and customer satisfaction (Bryant et al., 2004; De Deuser et al., 2009; Kaplan and Norton, 2001a, 2001b, 2001c, 2004; Malina and Selto 2001; Said et al., 2003). Furthermore, the BSC has been recognized as useful in aligning organizational vision and firms' objectives with daily operations (Kaplan and Norton, 2001b, 2004; Chenhall et al., 2011). Therefore, the academic world witnesses an increasing interest in connecting the BSC with innovation because of its promising effects on quantifying and transforming intangible assets (Kaplan and Norton, 2004).

Some researchers argue that the BSC is a valid tool to measure innovation, which identifies firms' advantages and disadvantages in innovation (Flores et al., 2009; Gama et al., 2007; Jones, 2007; Khomba et al., 2011). Additionally, the BSC has been described as a framework for highlighting firms' objectives and devising firm strategies to achieve innovation (Jarrar and Smith, 2011; Kaplan and Norton, 2004; Luo et al. 2012; Mohamed, 2013; Wu, 2012). However thus far, existing literature only provides a simple answer as to whether a relationship exists between the BSC and innovation without the detailed insights into factors behind the relationship and the consequences of this relation.

The implications of the BSC for innovation are unclear for three reasons. First, little effort has been made to outline the theoretical connection between the use of the BSC and

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innovation. Specifically, the question remains on whether the use of the BSC provides the resources and competences needed for innovation. Second, the contributions of the BSC on firm's innovation lack a single integrating framework. Third, the consequences of using the BSC and pursuing innovation remains unanswered. This paper addresses the research gaps by empirically investigating the following research questions: (1) Do companies that use the BSC perform better in terms of innovation? (2) What is the role of firm competences on the relationship between the use of the BSC and innovation? (3) What are the accounting and market consequences of innovation for firms that use the BSC?

Innovation requires firm resources, knowledge, and competences such as superior employee skills, propriety technology, extensive customer knowledge, and top management commitment. The RBV acknowledges the importance of valuable, rare, imperfectly imitable, and non-substitutable resources to a firm's competitive advantage (Barney, 1991). As an outgrowth of the RBV, the KBV highlights the central role of knowledge in organizational learning, management of technology, and innovation (Grant, 1996). I propose that these firm resources can be achieved by the appropriate use of management systems such as the BSC. The innovative performance measurement system can provide useful information in identifying and appraising firm resources related to the BSC perspectives including learning and growth, internal business process, and customer (Kaplan and Norton, 2001b). Furthermore, the different but related perspectives of the BSC drive the orientation of resource allocations in the according perspectives. Managers are more likely to allocate some of their limited resources to the development of firm competences in perspectives such as employee development, internal processes and

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customer relationships. Therefore, it is reasonable to assume that firms will outperform in those competences which enable them to be innovative.

The agency theory highlights the risk that managers may pursue self-interests because of information asymmetry. Innovation usually involves a long-term input of efforts and resources while the outcome or return is not immediate. Managers, whose compensation is based on the short-term firm financial performance, resist allocating limited resources to innovative projects or even accepting innovative proposals. The agency theory advocates the alignments of interests between the principal (shareholders) and the agent (managers) as a potential solution to agency problems (Jensen, 1983). Using the BSC in evaluating firm performance, firms usually base executive compensation on both financial and nonfinancial performance and further direct firms to focus on activities or operations such as innovation which have long-term benefits. Therefore, firms are more likely to engage in innovative activities if firms use the BSC as a performance measurement system to achieve the alignment between managers and firms' interests.

The contingency theory indicates the importance of recognizing the situational specifics in the design of any planning and control system (Fiedler, 1964, 1971). It is accepted that no one accounting system works for all organizations in all situations (Dermer, 1977). The appropriateness of a management control system to a firm depends on the firm specifics as well. Therefore, I propose that the relationship between the use of the BSC and innovation depends on whether firm competences act as a mediating factor between these two constructs. Additionally, I include several firm characteristics such as firm size, performance volatilities, and industry regulation in investigating the relation

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between the use of the BSC and innovation in order to address the situational influence in this study.

Based on all the theoretical foundations, this study develops a framework which proposes that the use of the BSC is associated with innovation. I hypothesize that the relation between the use of the BSC and innovation depends on whether it can be a facilitator to the overall competence development and in its three perspectives: employee, technology, and customer. It is argued that the association is explained by the paths from the use of the BSC to the firm competences, and then further firm competences are hypothesized to be positively associated with innovation. Additionally, I hypothesize that firm innovation that firm achieve from using the BSC is beneficial to business performance in terms of accounting performance and market performance. The theoretical framework is illustrated in Figure 1.1.

Using the American Society for Quality (ASQ) dataset, I identify firms that use the BSC as a strategic management control system (Bryant et al., 2004). The sample includes 230 public companies across different industries from 1995 to 2015. I identify firms that use the BSC by searching keywords such as "nonfinancial" and "strategic" in the Proxy Statements from the company filings database of the United States Securities and Exchange (SEC). Then, I merge the data with patent information collected from the United States Patent and Trademark Office (USPTO). In addition, I collect financial information from Compustat and market information from the Center for Research in Security Prices (CRSP). Due to the use of nested data in the study, I use multilevel regression to test the relationship between the use of the BSC and innovation and the role of firm competences in this relation. In order to address the potential endogeneity issues in the proposed positive

relationship between innovation for firms that use the BSC and firm performance, I utilize Two Stage Least Squares (2 SLS) to test the last set of hypotheses using panel data identified in this study (Heij et al. 2004).

This investigation provides empirical evidence that the use of the BSC is positively associated with firm innovation. The results confirm the mediating role of the overall firm competences as well as the specific perspectives of firm competences including employee, technology and customer competence in the relationship between the use of the BSC and innovation. This study offers evidence on the performance consequences of pursuing innovation as well. Innovation in firms that use the BSC is positively associated with market performance contemporaneously and prospectively. However, innovation is only positively associated with future accounting performance but not current accounting performance. These findings are validated for 150 US firms (1,773 firm year) over a 20-year period (1994-2015).

This study contributes to the existing literature in several ways. First, to the best of my knowledge, it is among the first to develop a theoretical framework proposing the use of the BSC as a strategic vehicle to promote innovation. It contributes to the understanding of innovation by incorporating multidisciplinary concepts from strategic management accounting and operations management. Second, this is the first attempt to empirically examine the role of firm competences on the relationship between the use of the BSC and innovation. It provides evidence on whether the use of the BSC enhances firm competences and whether firm competences facilitate innovation. Therefore, practitioners can benefit from the results with guidance on how to utilize the BSC as a strategic management control system to achieve innovation. Third, it explores the performance consequences of pursuing

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innovation for companies that use the BSC. This study attempts to find a rewarding effect for firms of utilizing the BSC to be innovative, further encouraging firms to engage in innovation and achieve competitive advantages. Lastly, this study enriches research methods by providing a new way to examine the use of the BSC, firm competences and innovation with archival data as the majority of prior research utilizes survey questionnaires (Jarrar & Smith, 2011; Mohamed, 2013). The availability of secondary data enables more research opportunities that contribute to the understanding of strategic management control systems and innovation.

The remainder of this study is organized as follows: Chapter 2 describes the existing literature of the BSC and innovation, followed by the supporting theories which act as the theoretical foundation in Chapter 3. The research model and hypotheses are then developed in Chapter 4, and Chapter 5 presents the research methodology. Results and discussions can be found in Chapter 6. Chapter 7 presents the conclusions, limitations and future research.
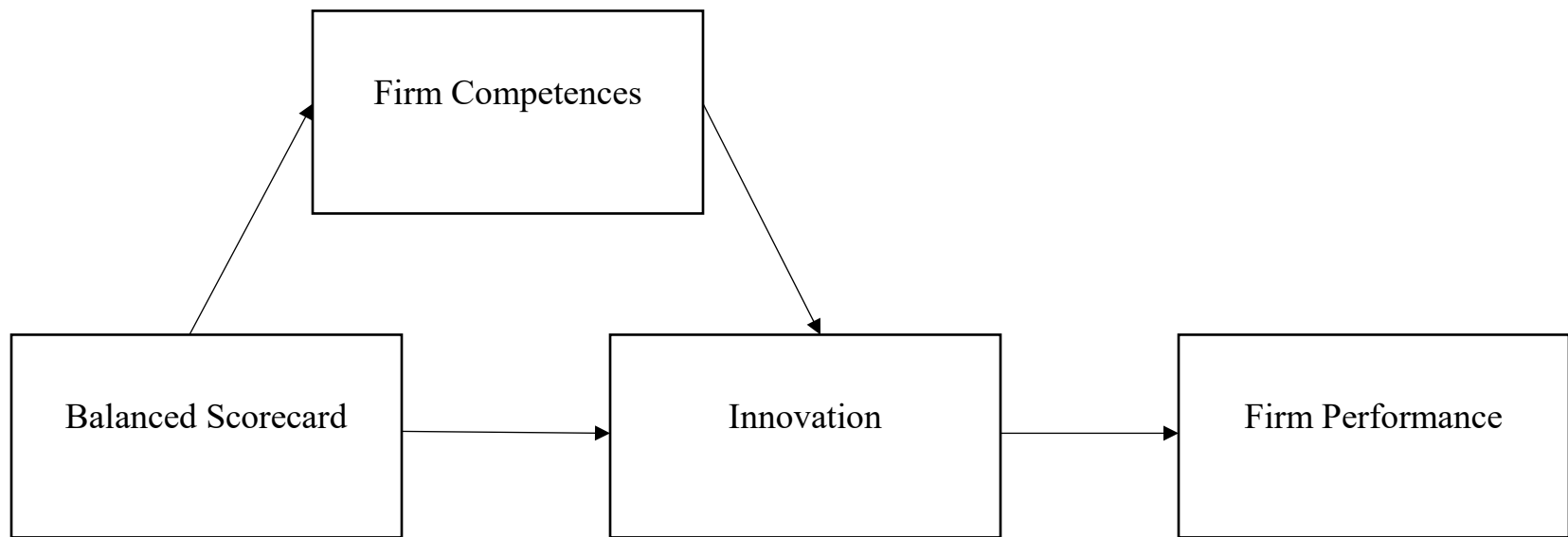
Figure 1.1 Theoretical Framework

Chapter 2

Literature Review

2.1 The Balanced Scorecard as a Management Control System

The BSC was introduced by Kaplan and Norton in 1992, with a premise that it is not sufficient to rely exclusively on financial results to measure firm performance and the importance of focusing on the drivers of financial performance (Kaplan and Norton, 1992). The BSC uses both financial and nonfinancial measures to evaluate whether the organization achieves the common strategic goals based on the core outcomes from four perspectives: learning and growth, internal business processes, customer, and financial (Kaplan and Norton, 2001b).

Learning and growth perspective acts as the foundation for any strategy. It specifies the employee capabilities, skills, and corporate climate that needed for firms to implement a strategy (Kaplan and Norton, 2001b). It enables firms to align the human resources with firm strategies in order to achieve desired objectives. The common outcome measures in this perspective include employee satisfaction, employee retention, and employee productivity (Niven 2002, p.140; Ittner et al. 1997; Kaplan and Norton 1996, 129). In

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addition, Bryant et al. (2004) use pension and retirement cost as a proxy for employee skills.

Internal process perspective identifies the means which facilitate internal value chain in terms of organizational activities. It includes supply chain management, resource-capacity management, and other processes (Kaplan and Norton, 2001b). All these organizational activities are beneficial for firms in order to achieve operational excellence. Kaplan and Norton (1996) suggest using the number of new products and services as a proxy for internal process. The other outcome measures include operating process quality and cycle time (Niven 2002, p.131; Ittner et al., 1997; Kaplan and Norton, 1996, p.100-107).

Customer perspective describes the detailed strategy that firms utilize to attract and sustain customers. It includes product or service mix, pricing strategy, customer relationship management and company image needed by firms to differentiate themselves from competitors (Kaplan and Norton, 2001b). Bryant et al. (2004) use customer satisfaction and market share to proxy for performance indicators of customer perspective. The other common measures of customer perspective include customer acquisition, customer retention, and customer profitability (Niven 2002, p.127; Kaplan and Norton 1996, p. 67).

Financial perspective refers to the traditional outcome desired by firms to pursue increases in shareholder value. It can be achieved through revenue growth and productivity enhancement (Kaplan and Norton, 2001b). Bryant et al. (2004) use revenue, operating costs, and net income to measure firms' financial performance. The other potential measures for companies to compare financial performance include sales, return on sales,

return on investments (ROI), return on assets (ROA), and earning per share (Corbett et al. 2005; Chen and Wong, 2004; Hall and Bagchi-Sen, 2002).

The four perspectives of the BSC lay the foundation for building a framework of strategy which facilitates firms to create a clear picture of firm objectives and an understandable reference for every level and employee within firms. More importantly, it enables firms to identify the drivers of financial performance. Specially, the use of the nonfinancial measures advocates the emphasis of long-term performance besides short-term performance (Banker et al. 2000; Johnson and Kaplan 1987; Kaplan and Norton 1992). The BSC motivates managers to allocate efforts and resources in nonfinancial perspectives which reward firms with positive outcomes such as better quality, customer satisfaction, and innovation (Said, et al., 2003). Therefore, the use of the BSC provides incentives for firms to focus on actions that leads to long-term benefits.

Prior studies provide significant evidence that the use of multiple performance measures in the BSC can have positive effects on firm performance (Banker et al. 2000; Bryant et al., 2004b; De Deuser et al., 2009; Evans et al., 2010; Ittner and Larcker, 1998; Kaplan and Norton, 2001a, 2001b, 2001c, 2004; Nagar and Rajan, 2001; Said et al., 2003). Some research investigates the relation between the use of the BSC and performance from the perspective of the internal linkage among the measures in the BSC (Bryant et al., 2004b; Kaplan and Norton, 2001a, 2001b, 2001c, 2004). Kaplan and Norton (2001b) point out that there exist the cause-and-effect linkages among the four BSC perspectives. In 2004, they further describe the BSC as a framework of value creation for both tangible and intangible assets. The BSC improves the communication within the organization by describing the strategy map for value creation, providing a structure to align all assets including tangible

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and intangible, and transforming the alignment into financial benefits (Kaplan and Norton, 2004).

BSC has been identified as a vertical value-creation process in which the outcome measures in the lower-level perspectives influence those in the higher-level perspectives (Kaplan and Norton, 2001a). Bryant et al. (2004) examine the relationship among the multiple performance measure and found value driven from interplays between each BSC perspective and outcomes of other perspectives. Moreover, the results show that there exists a positive relationship between customer satisfaction and new product or service introduction and financial outcomes only when firm uses both financial and nonfinancial measures (Bryant et al., 2004).

Other research examines the effects of the BSC on performance from the perspective that nonfinancial measures are better indicator of long-term performance than financial measures. Using two years' (1995-1996) survey data from a telecommunications firm, Ittner and Larcker (1998) examine whether customer satisfaction can be a predictor of future financial performance and find a significantly positive relationship between customer satisfaction and current market value. Using archival data from 18 hotels for 72 months, Banker et al. (2000) provide evidence that nonfinancial measures reflect information which cannot be disclosed in financial measure, and nonfinancial measures (e.g. customer satisfaction) are positively associated with firm financial performance. Based on archival data from a Fortune 500 firm, Nagar and Rajan (2001) examine the relationship between product quality measures and future sale. They find both financial and nonfinancial quality measures are leading predictor of future sales.

Said et al. (2003) investigate the implication of nonfinancial measures on firm performance and find that the mixed use of financial and nonfinancial measures is positively associated with return on assets and market returns. Additionally, they consider the contextual factors, environmental factors and strategic plans in adopting the nonfinancial measures. The research results highlight the significance of the fit between the use of the nonfinancial measures and firm characteristics. Said et al. (2013) find the firm performance of using nonfinancial measures depends on the match between the use of nonfinancial measures and firms' operational and competitive environment.

Using survey data, De Geuser et al. (2009) confirm that the BSC does create value. The study found that the development of the BSC tend to be positively associated with better organizational performance in terms of management evaluation of the BSC success, cost-benefit relationship, the integration of key management processes and the business units' autonomy. Additionally, the results provide answers to how BSC creates value support. It depends on the translations of strategies into processes and alignments of organizational resources. The study supports that the BSC represents a value-added management system connecting firms' actions with their strategies (De Geuser et al., 2009).

Besides financial performance as the major outcome of using the BSC, prior research provide evidence on the use of the BSC on nonfinancial performance as well. Using a national survey from 1996 to 2005, Evans (2010) examine the use of nonfinancial performance measures in physician compensation, and find that the use of nonfinancial measures is associated with individual physician productivity.

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Since its inception by Kaplan and Norton, the BSC has been recognized more as a strategic management control system which links with firm strategies than a simple performance measurement system which collects financial and nonfinancial measures (Baiman and Baldenius, 2009; Bisbe and Malagueno, 2012; Campbell et al., 2015; Kaplan and Norton, 1996, 2001a, 2001b, 2001C; Malina and Selto, 2001; Tayler, 2010). Kaplan and Norton (1996) emphasize that the BSC contains the cause-and-effect measures which are derived from the business strategy. Malina and Selta (2001) examine the effectiveness of the BSC in communicating and controlling firm strategies using empirical interview and archival data. The results indicate that the BSC is an effective device in controlling firm strategies and also provide evidence on the causal relations between effective management control, strategic alignment and beneficial effects of using the BSC.

Using analytical method, Baiman and Baldenius (2009) investigate the use of nonfinancial performance measures as a coordination device among divisions. Linking division managers' interests with joint project profitability, they find that the use of nonfinancial performance measures is positively associated with project implementation efficiency. Tayler (2010) conducts an experiment to examine the use of the BSC as a strategy-evaluation tool in mitigating the effects of motivated reasoning where "individuals tend to evaluate and interpret data in ways consistent with their preferences" (p.1099). The results confirm the findings from prior studies, highlighting the importance of managers' involvements in selecting the BSC measures and framing the BSC as a causal-chain (Taylor, 2010).

Using archival and survey data from 267 Spanish companies, Bisbe and Malagueno (2012) find that using the BSC as a strategic performance measurement system can shape

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strategy formulation processes and further influence firm performance. Campbell et al. (2015) investigate the use of the BSC in testing strategy and find that the BSC can provide more timely information about the "formulation, implementation and fit" of the strategies. Additionally, their study points out the useful role of the BSC plays in identifying problems and causes of strategy failures. It also emphasizes the necessity of the fit between firm strategy and firm competences in achieving success including positive customer experience and financial performance.

In summary, the existing literature supports the role of the BSC as a strategic management control system which links the performance drivers with performance outcomes. Additionally, the BSC is advocated as a value-creation framework and strategy tool which rewards the firms with favorable financial and nonfinancial benefits.

2.2 Innovation

Facing the dynamic business world, firms recognize the need for developing the capability to provide products or services not only to satisfy the market demand but also be superior to their competitors. Innovation is the preferred solution because it enables firms to survive and prosper in fast-changing business setting (Danneels, 2002). Firms are eager to be innovative with the purpose of developing and sustaining their competitive advantage. With the increasing awareness about the importance of innovation to competitive success, managers strive to understand what innovation really is by identifying the sources and the typology of innovation.

Prior literature has generated a list of definitions for innovation. It goes back to 1930s when Schumpeter describes innovation from the economic development point of view. He argues that innovation results from novel combinations by entrepreneurs

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(Schumpeter, 1934). Drucker (1984) defines innovation as "the effort to create purposeful, focused change in an enterprise's economic or social potential" (p. 67). Innovation is segmented into two different strata. The first exists within the organization, and the second appears external to the organization (Drucker, 1984). Drucker (1984) identified four areas as potential opportunities for innovation within the organization are: unexpected occurrences, incongruities, process needs, and industry and market change. The areas external to the organization includes demographics, changes in perception and new knowledge (Drucker, 1984). Roberts (2007) argues that innovation is composed of invention and exploitation. The invention includes idea generations and efforts to realize the idea, while the exploitation covers all the processes of conversion into business outcomes (Roberts, 2007). Similarly, Betz (2011) defines technological innovation as "the invention of a new technology and its introduction into the marketplace as a new hi-tech product, process, or service" (p. 12).

A large stream of research in the organization economic literature focuses on the relationship between innovation and organizational characteristics with emphasis on explaining the differences in innovation performance across organizations (Del Canto and Gonzalez, 1999; Ryu et al., 2015; Srivastava and Gnyawali, 2011). Researchers are motivated to study the factors that influence innovation and understand how innovation occurs within firms. With the evolutionary theory such as the RBV, a few internal resources are identified to impact firms' in-house innovation. Del Canto and Gonzalez (1999) find that financial resources, physical resources and intangible resources are major players in determining organizational activities in carrying out innovation. Firms can pursue different outcomes by having different priorities on the resources. Additionally, relational resources

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is critical in fostering breakthrough innovation (Srivastava and Gnyawali, 2011). Researchers find that the quality and diversity of portfolio technological resources through the alliance between different organizations can contribute to firms' innovation performance. Besides, alignment between innovation strategy and business strategy is also important in influencing firm performance (Ryu et al., 2015). It points out that organizations can pursue innovation benefits by aligning the innovation strategy with business strategy based on the attributes of innovation they intend to achieve.

When it comes to the type of innovation, the existing literature offers several classifications. Innovation is originally classified as product or process innovation (Tushman and Nadler, 1986). Later, Francis and Bessant (2005) suggest that the dichotomy of innovation should consider the market position and business models as well. Specifically, they propose the four "Ps" of innovation based on four aspects: "1) P1 innovation to introduce or improve products; 2) P2 innovation to introduce or improve processes; 3) P3 innovation to define or redefine the positioning of the firm or products; 4) P4 innovation to define or refine the dominant paradigm of the firm" (Francis and Bessant, 2005, p. 172). Based on the degrees of innovation, innovation can be classified as incremental or radical (Miller et al. 2005). Incremental innovation is improvement based on the existing technology, products, services, and processes, while radical innovation is based on substantially new technology, products, services and processes relative to what already exists (Chandy and Tellis, 1998; O' Connor, 1998).

Claiming incremental-radical categorization as incomplete, Henderson and Clark (1990) examine innovation in an architectural way by separating the components of a product from the way it is integrated. They divide innovation into four types based on two

knowledge dimensions: components knowledge and architectural knowledge. Innovation is incremental when both are enhanced and is radical when both are destroyed. Modular innovation happens when architectural knowledge is enhanced while component knowledge is destroyed. Architectural innovation exists when component knowledge is enhanced and architectural knowledge is destroyed (Henderson and Clark, 1990). Drawing on the Henderson and Clark's framework, Christensen (2006) comes up with a new typology of sustaining and disruptive innovation. Different from radical innovation, disruptive innovation does not necessarily involve the new technology as radical innovation does but it targets at emerging market which is unattractive to the mainstream customers (Govindarajan et al., 2011).

As the world is becoming more and more connected, firms are realizing the importance of cooperation with peer companies in the specific field and the necessity of mutual learning from each other when it comes to boosting new ideas and mastering new knowledge. It is extremely crucial to be innovative which requires different ways of thinking and different ways of doing things. Since the beginning of the 21st century, more and more organizations go beyond the company boundary and start to turn to the outsiders for new voices. As a result, open innovation was introduced in a book by Chesbrough in 2003, which proposes a new model for innovation.

The traditional innovation, or as called closed innovation, relies on the internal activities from the science and technology base of the firm to develop new products, services, and processes. Open innovation, at the other hand, utilizes the external and internal knowledge to "accelerate internal innovation and expand the market for external use of innovation" (Chesbrough, 2006; 2012). Open innovation refers to the new paradigm

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where firms combines the new ideas both within and outside firms; where firms use both internal and external paths and resources to access the market; where firms share their unused ideas with the outsiders in order to advance their own innovation or for others to benefit. In the business setting, it is the collaboration between two firms or more to come up with something new but now this issue becomes more complex because there are many parties involving in the innovation process such as suppliers, buyers, and partners (Cheesbrough, 2012).

The existing literature provides some empirical evidence on the trends of innovation and offer suggestions on how to manage innovation in order to achieve firm success. Using survey questionnaire conducted in 2013 from 416 members of the Product Development and Management Association, Barczak et al. (2009) identify the practices associated with high degree of success in new product development. They find that various software support tools are heavily used in new product development and firms' success in innovation depends on the improved management including project leadership, training, communication support, and customer needs identification. More importantly, the common factor among the best firms in innovation is the emphasis and integration of their innovation strategy within the firms. Based on the interviews of more than 40 multinational enterprises (MNE) in German and the UK, Kramer et al. (2011) explore the role of two specific intangible assets—organizational and network capital in firm innovation. They find that the organizational capital enables MNEs to achieve financial benefits in perspective of R&D and knowledge creation, and network capital improves MNEs' integration with other actors in the network. The study highlights the importance of capital from inside and outside firms.

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In summary, the existing literature offers numerous conceptual studies indicating the sources of innovation but very few studies provide empirical evidence on the determinants of innovation. In addition, no prior study examines the enabler of innovation from the perspective of management control system.

2.3 The Balanced Scorecard and Innovation

The BSC connects organizational vision with its objectives and enables organizations to focus on its priority, fostering the improvement of the four perspectives and further leading the organization to future success. Due to its intangibility and immeasurability, innovation is of high complexity and difficulty to achieve. Therefore, firms allocate tremendous efforts and resources in aligning management strategy with organization operations in order to generate and sustain the competitive advantage by fostering innovation. With its promising effects on transforming firm's vision into detailed operations, the BSC as a strategic management control system has attracted research interests as related to innovation (Flores et al., 2009; Gama et al. , 2007; Jarrar and Smith, 2011; Khomba et al., 2011; Luo et al. , 2012; Mohamed, 2013).

One stream of the existing research on the BSC and innovation is to utilize the BSC as a tool to measure and quantify innovation (Flores et al., 2009; Gama et al., 2007; Jones, 2007; Khomba et al., 2011). Based on the innovation metrics and the traditional BSC concepts, Gama et al. (2007) conceptually propose an innovation scorecard to measure the value added by innovation with the intention to align the scorecard with the organization's strategic objectives. They argue that the combination of the BSC and innovation metrics can enable organizations to associate the innovation projects with the strategy. They identify a portfolio of innovation metrics that could be adopted by organizations: "number

of ideas generated, time consumed in innovation, growth of market share, ROI of new products and so on" (Gama et al., 2007).

Similarly, Jones (2007) conceptually proposes a 3-dimensional BSC model for strategic Research and Development (R&D) management in healthcare. The proposed model includes four perspectives: resources, stakeholders, R&D management process, and learning and innovation. The 3-dimensional structure was reflected in a model with R&D processes from idea generation to practices as the center and each of four perspectives as a vertical face of the cube-shaped model (Jones, 2007). Khomba et al. (2011) redesign the innovation perspective of the BSC to better suit the organizations in African culture. The new African innovation perspective consists of four components: Africanisation values, learning values, customer values and innovation values. The authors used survey questionnaires and interviews among 18 large Malawian companies to provide the empirical evidence on the impact of the BSC on firm performance. The research results suggest the necessity of considering situational factors when using the BSC (Khomba et al., 2011).

In order to measure Industry-University collaborative environment, Flores et al. (2009) develop a new BSC as a tool to assess the impact of collaborative research. The proposed scorecard includes six perspectives: competitiveness, sustainable development, innovation, strategic partnerships, human capital and internal business process. Using interviews and survey questionnaire for a specific project by CEMEX Research Group and Cranfield University, Flores at al. (2009) confirm that a collaborative BSC is useful to evaluate the impact of conducting collaborative projects with universities.

The other stream of research on the BSC and innovation examines the role of the BSC in aligning and transforming organizational intangible assets (Jarrar and Smith, 2011; Kaplan and Norton, 2004; Luo et al., 2012; Mohamed, 2013; Wu, 2012). As the ultimate source of value creation, intangible assets play an important role in organizational success in terms of adding value to customers and improving the shareholders' benefits. The BSC, as a tool to quantify the intangible assets, provides a framework of strategies for value creation from both tangible and intangible assets and also acts as a language to describe and direct the organization to its priority (Kaplan and Norton, 2004). The BSC has also been used as an operational level strategic planning tool for service innovation because it is an interactive system which can highlight management objectives and improve the processes (Luo et al., 2012)., Luo et al. (2012) used interviews and observations of four Taiwanese hospitals to examine the entire process of the strategic planning using the BSC in hospitals. Assessing divisional and hospital performance in four major perspectives of the BSC, the authors provide evidence that the BSC can be helpful in understanding the drivers of strategic planning and also in linking the service innovation between operation and business level.

Besides these benefits, the BSC has been confirmed to have positive effects on the use of management initiatives and organizational innovation as well. Surveying top executives' perception towards drivers of using the BSC and the effects of the BSC on choosing management initiatives in Australian manufacturing industry, Jarrar and Smith (2011) examine the relationship between product diversification and firm performance with the BSC as a link to improved performance including innovation. The results provide evidence on the appropriateness of the BSC to companies with diversified products and its

key role in facilitating the relationship among product diversification, innovation, and innovative management initiatives of total quality management (TQM) and Just-In-Time (JIT) (Jarrar and Smith, 2011).

Surveying managers in financial, human resource and marketing departments, Wu (2012) examines the relationship between the use of the BSC and intellectual capital accumulation in Taiwan-listed companies. Using corporate innovation activities as the extraneous variable, the author is able to test whether there is a relation between the use of the BSC and corporate innovation activities in facilitating the intellectual capital accumulation. The results of the structural equation modeling confirm the existence of the synergy that benefits the accumulation of human capital, structural capital and relationship capital (Wu, 2012).

A more direct relationship between the BSC characteristics (diversity, balanced use and strategic linkage of performance measures) and innovation has been examined by Mohamed (2013). Based on survey results of 80 Egyptian companies, the author investigates the relationship between each characteristic of the BSC and innovation. Mohamed (2013) provides empirical evidence that the balanced use of performance measures can have positive effects on innovation (Mohamed, 2013). The findings indicate a potential linkage between the use of the BSC and innovation.

Taken together, the existing literature on the relation between the use of the BSC and innovation only provides a simple "yes or no" answer to the question on whether the use of the BSC is associated with innovation. To the best of my knowledge, no prior study has attempted to look into the relationship and identify why and how such relationship exists. The "why and how" question is crucial for firms intended to be innovative because

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the answer can provide guidance on how to achieve innovation. The lack of theoretical framework between the use of the BSC and innovation, and performance consequences of pursing innovation with the use of the BSC opens up research opportunities to understand more about innovation, explore the role of the BSC in linking firm strategies with firm priorities, and empirically investigate how firms can benefit from using the BSC as a strategic management control system.

Chapter 3

Theoretical Background

3.1 Resource-Based View

The RBV describes and classifies the sources of sustained competitive advantage in four indicators of firm resources: value, rareness, imperfect imitability and substitutability (Barney, 1991). Firm resources represent the strengths of a firm, the position that firm can occupy in competitive market, and further the possibility of achieving superior return. Firm resources are useful in yielding competitive advantage only if they can be identified as valuable, rare, inimitable and non-substitutable (Barney, 1991).

Firm resources are not limited to just physical asset but include "capabilities, organizational processes, firm attributes, information, knowledge, etc." (Barney, 1991; Daft, 1983). The RBV perceives the firm as a collection of all available resources and capabilities. The primary task of management is to look for ways to sustain and fully utilize those existing resources and achieve more desired resources, and further enable firms with competitive advantage and superior performance (Grant, 1996).

Resources and capabilities build the foundation for firms' strategy on the condition that they direct firms towards their strategic objectives and they are also primary sources of profit. Grant (1991) argues that the resources have an important influence on what firms

can do because they place a limitation on the range of what they can perform. Additionally, the availability of resources is crucial to firms' capability because the development of the desired capability or competence requires the involvement and coordination of specific resources including physical resources like raw materials and intangible resources like human capital.

Innovation requires firm resources including skilled employee, propriety technology and extensive customer knowledge. In this study, I propose that these firm resources can be achieved by the appropriate use of management control systems such as the BSC because the innovative performance measurement system can provide useful information in identifying and appraising firm resources. Furthermore, the different but related perspectives of the BSC drives the orientation of resource allocations in the according perspectives. Managers are more likely to allocate limited resources to the development of firm competences in perspectives such as employee development, internal processes and customer relationships. Therefore, it is reasonable to assume firms using the BSC will outperform in those competences which enable firms to be innovative.

3.2 Knowledge-Based View

As an outgrowth of the RBV, the KBV focuses on recognizing "knowledge as the most strategically important firm resource" (Grant, 1996). Grant (1996) points out the central role of knowledge in research areas such as organizational learning, management of technology, managerial cognition and organizational innovation. Besides addressing the traditional concerns including strategic choice and competitive advantage, the KBV also discusses other primary firm concerns involving "the nature of coordination with the firm,

organizational structure, the role of management and the allocation of decision-making rights, determinants of firm boundaries, and the theory of innovation" (p. 110).

As the foundation of the KBV, knowledge forms the basis for the logic development because the KBV is mainly about the value creation through the use of knowledge. The understanding of the knowledge becomes the necessity for establishing firm theory. Grant (1996) identified characteristics of knowledge that can be utilized for value creation. First, knowledge is transferable. It is the critical factor enables firms to confer sustainable competitive advantage (Barney, 1986). Each individual type of knowledge requires unique mechanism to transfer. Explicit knowledge can be transferred using verbal or nonverbal communication, while implicit knowledge needs application and practices to deliver. Second, knowledge has the capacity for aggregation. Knowledge aggregated when individuals and firms absorb and add the new knowledge to the existing base. The aggregation of knowledge enhances the efficiency of knowledge transmission. With the advances in information technology, knowledge can be greatly aggregated and transferred for optimal decision making. Third, knowledge is a resource of appropriability. The definition of appropriability refers to that owners of a resource can expect a return from using the resource (Levin et al., 1987). Knowledge can be appropriated based on the outcome of the application such as productivity. But besides patents and copyrights which are protected legally, most knowledge cannot be appropriated due to the ambiguity of ownership (even though it is the individual within firms who has knowledge, but the knowledge is created within the firm).

The KBV offers a theoretical basis in understanding the various needs of innovation. Innovation involves identifying what the customer needs, what resources and

knowledge firms need to satisfy the demands, and how to provide the desired products and services or how to do it in a more efficient and effective way. The knowledge related to answering such questions are critical in firm innovation. In this study, I propose that the use of the BSC can foster learning environment which encourage knowledge sharing and accumulation. The customer perspective of the BSC provides information about customer needs and preferences. The BSC includes the leaning and growth perspective which focuses on employees' capability and skill developments. The internal business perspective of the BSC encompasses the entire internal value creation. Therefore, the use of the BSC is more likely to provide the necessary knowledge for firms to be innovative.

3.3 Agency Theory

The agency theory origins in the risk-sharing problem which goes back to 1960s (Wilson, 1968). It describes the situation where the principal delegates the rights to the agent, and the agent performs the work on behalf of the owner. According to Eisenhardt (1989), the agency theory is useful in explaining and addressing the agency relationship related problems: the conflicts of the goals and interests between the principal and the agent, and the verification of the agent work—whether the agent is doing the work appropriately. The agency theory has been applied to a wide range of research topics including compensation, ownership, financing structure and innovation (Eisenhardt, 1989; Bolton, 1988).

The two major research streams related to the agency theory are positivist and principal-agent (Jensen, 1983). The positivist agency theory focuses on identifying the conditions that trigger the conflicting targets between the principal and agent, and providing recommendations in terms of governance mechanisms to discourage the agents'

seeking for self-interests. Existing literature points out the promising effects of outcome-based contracts and the use of information systems in curbing agent opportunism (Fama & Jensen, 1983; Jensen & Meckling, 1976). The principal-agent research focuses on identifying the optimal principal-agent contracts or relationship involving the differing levels of "outcome uncertainty, risk aversion, information" (Eisenhardt, 1989). Overall, the agency theory recognizes the importance of self-interest in understanding the management behavior and the usefulness of incentives in directing the organizational thinking.

Eisenhardt (1989) provides recommendations for the agency theory research. Among them, innovation is identified as an attractive topic because it combines the varying factors in decision making such as goal conflict, risk and difficulty in performance evaluation. The BSC provides outcome-based performance measures which capture an in-depth display of firm performance, and the four perspectives of the BSC offer a complex view to enhance stakeholders' information richness in understanding organizations. Therefore, I propose that the BSC can be useful in limiting agency problems since it aligns the interests between the principal (the stockholder) and the agent (the management) and provides useful information to verify agent behaviors. More importantly, it encourages the emphasis of innovation as a sole perspective in the BSC. It is reasonable to assume that management will be willing to be more involved in innovation for long term benefits or competitive advantage when they have aligned interests with the owner.

3.4 Contingency theory

Originated in leadership, the contingency theory argues that leadership performance depends on the person and situation interaction. No one style, set of behaviors

or possession of traits will be effective in all situations. This theory, which goes back to the early 1960's, recognizes the moderating effects of the situation in the relationship between the leader behaviors or traits and leadership effectiveness or outcomes (Fiedler, 1964; 1971).

Later in the mid-1970's, researchers started to use the contingency framework for the analysis of other disciplines especially in the field of behavioral and organizational aspects of management accounting (Otley, 1980). Horngren (1972) argues that it is really inseparable and interdependent to design a (management accounting) system and to design an organizational structure. The view is further reinforced by Dermer (1977) who emphasizes the situational specifics in the design of any planning and control system. The premise for the inter-relationship between contingency framework and management accounting is that no one accounting system works for all organizations in all situations. The appropriateness of the accounting system is contingent on specific features desired by the organizations in different situations (Otley, 1980).

As a further development, Balkin and Gomez-Mejia (1987) link the compensation strategy with the contingency theory, which ties the compensation system with the organization's operating objectives and strategies. They argue that firm characteristics influence the compensation strategy. More specifically, the effectiveness of the compensation system depends on the firm stage of the product life cycle and the company size.

Based on the contingency theory, it is crucial to take firm characteristics into consideration of choosing the appropriate management control system. Therefore, I propose that the relationship between the use of the BSC and innovation depends on

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whether firm competences act as a mediating factor between these two constructs. Additionally, I include several firm characteristics such as firm size, performance volatilities, and industry regulation in investigating the relation between the use of the BSC and innovation in order to address the situational influence in this study.

Chapter 4

Hypotheses Development

The existing literature has provided some evidence on the relation between the use of the BSC and innovation (Jarrar and Smith, 2011; Kaplan and Norton, 2004; Luo et al., 2014; Mohamed, 2013; Wu, 2012). However, these studies only provide a simple answer as to whether a relationship exists between the BSC and innovation without looking into the theoretical connection to explain why and how such relationship exists. Additionally, the results are mainly based on survey response rather than using archival data. Moreover, no empirical evidence has been provided to verify performance consequences. Based on the RBV, the KBV, the agency theory and the contingency theory, this dissertation proposes a framework on the use of the BSC and innovation from both accounting and operations management perspectives, and its accounting and market performance consequences.

Figure 4.1 summarizes the theoretical linkages of the main constructs in this study. The left upper part of the framework directly explores the relationship between the use of the BSC and innovation; the left lower part describes how innovation is enhanced by the three specific competences as well as firm's overall competences from the application of the BSC. Specifically, it presents the relationship between the use of the BSC and firm

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competences: employee competence, technology competence and customer competence. Further the model examines the paths from the three firm competences to innovation. The right part of the framework investigates the implications of innovation and the use of the BSC on accounting and market performance.

4.1 The Use of the BSC and Innovation

The original paper by Kaplan and Norton (1992) describes the BSC in four perspectives: financial, customer, internal business process, and leaning and growth. The internal business process perspective aims at achieving the differentiated value proposition and also the efficiency and productivity in the process (Kaplan and Norton 2001). It includes four processes that capture the critical organizational activities: operations management processes, customer management processes, innovation processes, and regulatory and social processes (Atkinson et al., 2011, p.26). As indicated by the components, innovation is just a sub-process in the internal business process perspective. Later some researchers directly treat the internal business perspective as innovation due to the increasing emphasis on innovation as the source of competitive advantage. While the original perspective focuses on what the firm should excel at, innovation is only a possible answer to that but not the only one.

Performance measures play a vital role in innovation. Breakthrough innovation requires a set of measures which include tracking input and output in innovation. More importantly, it needs portfolio measures that provide information that captures the entire innovation process and the integrations of the different factors (Frigo, 2015). The internal process perspective of the BSC enables firms to gather such information for the internal value chain.

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Based on the RBV, it is essential for firms to identify the availability of firm resources in order to develop and sustain competitive advantages. The BSC provides a clear picture of firms' resource base than traditional management information systems using only financial statements. Traditional financial statements disregard intangible resources such as human skills which are the important resources for firms to achieve competitive advantage (Grant, 1991). The BSC describes a framework for quantifying both tangible and intangible resources. Therefore, it enables firms to identify those strategic resources they have or lack. The information has an important bearing on what the firm can do since it determines whether the firm have what is needed to achieve its objectives. Firms can either develop or achieve the needed resources accordingly.

The existing literature provides some evidence on the use of the BSC and innovation. Jarrar and Smith (2011) suggested using the BSC for product diversified companies to achieve better performance including innovation. They conduct survey questionnaires to collect top managers' perceptions about the drivers of using the BSC and the effects of the BSC on choosing management initiatives in the Australian manufacturing industry. Based on the responses from 105 companies, they conclude that the BSC is appropriate for product diversified companies. In addition, they also find that the BSC plays a key role in facilitating product diversification and firm performance in terms of innovation (Jarrar and Smith, 2011).

Wu (2012) examines the effects of the BSC on intellectual capital accumulation in Taiwan-listed companies. The author conducts interviews on the managerial staff in financial, human resource and marketing departments. Using corporate innovation activities as the extraneous variable, the author is able to test whether there is a relation

between the use of the BSC and corporate innovation activities in facilitating the intellectual capital accumulation. The results of the structural equation modeling confirm the existence of the synergy that benefits the accumulation of human capital, structural capital and relationship capital (Wu, 2012). Mohamed (2013) examines a more direct relationship between the BSC characteristics (diversity, balanced use and strategic linkage of performance measures) and innovation. Based on the survey results from 80 Egyptian companies, the author provides empirical evidence that the balanced use of performance measures have positive effects on innovation (Mohamed, 2013). These findings indicate a potential linkage between the use of the BSC and innovation.

The BSC is a framework of strategy which facilitates firms to create a clear picture of firm objectives and an understandable reference for every level and employee in the firms. Specially, the use of the nonfinancial measures promotes the emphasis of long-term performance besides short-term performance (Banker et al. 2000; Johnson and Kaplan 1987; Kaplan and Norton 1992). The agency theory advocates the alignment of interests between managers and owners in directing management behavior and organizational thinking. The BSC is recognized to link firm strategy with operations and evaluate managers' performance based on both financial and nonfinancial indicators. The BSC motivates managers to allocate efforts and resources in nonfinancial perspectives which rewards firms with positive outcomes such as innovation (Said, et al., 2003). Using the BSC as a performance measurement system, mangers will be more willing to involve in innovation for long term benefits.

Learning and growth perspective of the BSC specifies the employee capabilities, skills, and corporate climate that needed for firms to implement a strategy (Kaplan and

Norton, 2001b). This perspective enables firms to align the human resources with firm strategies in order to achieve desired objectives. Internal process perspective identifies the means which facilitate internal value chain in terms of organizational activities. It includes supply chain management, resource-capacity management and other processes (Kaplan and Norton, 2001b). All these organizational activities are beneficial for firms to achieve operational excellence. Customer perspective describes the detailed strategy that firms can utilize to attract and sustain customers. It includes product or service mix, pricing strategy, customer relationship management and company image needed by firms to differentiate from competitors (Kaplan and Norton, 2001b). Therefore, the use of the BSC is likely to facilitate firms to achieve strategic objectives such as innovation which requires a long-term involvement. Taken together, I hypothesize that:

H1: The use of the BSC is positively associated with firm innovation.

4.2 Firm Competences and the Relation between the BSC and Innovation

Based on the RBV and the KBV, firms' growth relies on their ability to deploy and accumulate firm resources and knowledge (Barney, 1991; Danneels, 2002; Grant, 1996). Firms' abilities identified as successful in achieving predetermined goals are recognized as firm competences. Firms are recognized as the entity which acquires and accumulates competences for above-normal returns (Knudsen, 2012). Firm competences are the mechanism by which firms achieve their strategic objectives, both financial and nonfinancial. The competence perspective of firm explains how some firms can outperform the peer competitors. Prahalad and Hamel (1990) argued that the differences in firms' rent-earning are due to the difference of firms' resource bundle or later called as competences.

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Foss (2012) emphasized the importance of the resource and competence in developing and sustaining long-lived competitive advantage.

In order to achieve innovation, it's not preferred but required that the firms develop and combine competences in deploying resources and integrating strategies (Rubera et al. 2012). Firms' strategic management, which provides the right reference for priority and leads the direction for success, is unavoidable in either the employment of existing competencies or the development of new competences (Danneels, 2002; Kaplan and Norton, 1996). Therefore, I suggest that firm competences in general are the construct missing from the relationship between the use of the BSC and innovation. Prior research has not been able to demonstrate consistent findings in explaining the linkage between the BSC and innovation. In this study, I propose firm competences as a mediator rather than a moderator in the relation between the use of the BSC and innovation. The proposition is based on the existing literature which consistently argue that firm competences such as technology and customer competence are the enablers of innovation (see Danneels, 2002; Junkunc, 2007; Siguaw et al. 2006,). Including firm competences as a mediator in the relationship recognize that without the required firm competences, the use of the BSC may not be effective in promoting innovation. Therefore, I hypothesize that:

H2a: Firms' overall competences mediates the relationship between the use of the BSC and innovation.

Considering the first hypothesis (that the use of the BSC is positive associated with firm innovation) is supported, the second set of hypotheses indicates a partial meditating role of firm competences (either in general or specific competence) in the relationship between the use of the BSC and innovation. In addition to firm competences in general,

firms interested in innovation need to develop competences in perspectives such as employees, technology and customers for superior employee skills, propriety technology and extensive customer knowledge, respectively. Those competences are primary aspects in the BSC which are used by firms as a strategic management control system. Therefore, I propose the specific firm competences has mediating effects on the relation between the use of the BSC and innovation as well.

4.2.1 Employee Competence

The integrated framework developed by Ariss and Deilami (2012) identifies a list of factors that affect innovation. Among them, employee competence is a major internal factor that cultivates innovation. Employee competence is the foundation of the firms' further development in all areas such as new product design, operations management, and customer relationship management. Traditionally, employee competence includes the experience, knowledge, abilities, skills and wisdoms of the individuals within the organization (Barney, 1991). The primary goal of achieving employee competence is to enable firms' successful operations which involve every individual within the firms. Based on this perspective, firms benefit from employees' work if each individual can do well in assigned jobs. I define employee competence in this study as employees' ability required for the successful accomplishment of tasks.

Simple financial incentives only offer marginal benefits for innovation because they do not inspire the passion and creativity needed for innovation particularly breakthrough innovation (Frigo, 2015). The learning and growth perspective of the BSC enables firms to define employee skills and corporate climate needed to support their strategy (Kaplan and Norton, 2001b, 2001c). For firms pursuing innovation, they can use

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the BSC to define the corporate climate as leaning and sharing which stimulate new ideas and further foster innovation activities.

The BSC includes the perspective of learning and growth which focuses on employees' capability and skills, and corporate climate. Metrics in this perspective enable managers to know better about the organizational knowledge base. It guides the managers to allocate the limited resources within firms to that foster learning and knowledge building. Siguaw et al. (2006) argue that firms with strong employee orientation are more likely to "implement formal and informal policies" to improve mentor or training environment, ease the communication among employees, and stimulate employee competence development (p. 565). Therefore, the firm's orientation in the perspective of learning and growth, cultivated by the use of the BSC, fosters the development of employee competence needed for innovation.

Earlier studies have confirmed the importance of employee competence in R&D activities. In Grant's (1996) point of view, knowledge plays a critical role in production and value creation. Canto and Gonzalez (1999) find that the availability of qualified human capital is positively associated with the realization of R&D activities. Junkunc (2007) argues that the specialized employee knowledge and skills are necessary conditions for breakthrough scientific innovation. Therefore, when knowledge becomes more specialized and more valuable, the organization tends to invest more in the individuals to prevent losing them to competitors (Junkunc, 2007).

Based on the RBV and the KBV, firms' success in achieving innovation rely heavily on the availability of firm resources. The BSC empowers firms in cultivating learning and knowledge development within the organization at both the individual and

corporate level. The output of the learning and growth perspective is the necessary input for further innovation-directed actions. The agency theory advocates the alignment of interests between managers and owners in directing management behavior and thinking. The use of the BSC direct firms' thinking and behavior towards firm objectives. Firms with innovation orientation tend to achieve the necessary firm competences including employee competence. The use of the BSC enables firms to allocate resources in the development of employee competence and enhance employee competence, which in turn, benefiting firms to be innovative. Therefore, I hypothesize that:

H2b: Firm's employee competence mediates the relationship between the use of the BSC and innovation.

4.2.2 Technology Competence

Technology competence refers to the ability of using technology related resources to accomplish the desired output in terms of products and service. Danneels (2002) identified the components of technology competence, including manufacturing plant and equipment, manufacturing/engineering know-how, and quality control. In this study, I define technology competence as the ability to apply technically related resources (manufacturing facilities, technology know-how, and quality control system) in producing high-quality products/services or facilitating management-controlled activities.

The internal business process of the BSC encompasses the entire internal value chain (Bryan et al., 2004). It enables firms to identify the critical organizational activities that focus on innovation and the processes to enhance customer relationships. The four processes included in this perspective are: franchise building, customer management, operational excellence, and regulation and environment (Kaplan and Norton, 2001b). All

the four processes are closely correlated and promote the development of internal competence such as technology competence, which is the competence of applying technology in terms of producing high-quality products/services or facilitating the management-controlled activities, leading to the ultimate achievements of innovation. Therefore, the firm's orientation in the perspective of internal business, cultivated by the use of the BSC, encourages the development of technology competence needed for innovation.

Innovation-orientated firms specifically require technology competence that facilitate new learning and improvement in administrative and work process (Ariss and Delilami, 2012). The well-designed and efficient processes are more likely to provide differentiated and creative products to customers. Danneels (2003) argues that competences related to technology and customer are required for product innovation because products are an integration of markets (customer) and technologies. Therefore, a firm's ability to provide desired products or services to the market depends on its technology development.

In summary, the use of the BSC direct firms' thinking and behavior towards firm objectives. Firms with innovation orientation tend to target at achieving the necessary firm competences including technology competence that needed for innovation. The use of the BSC enables firms to allocate resources in the development of technology competence and enhance technology competence, which in turn, benefiting firms to be innovative. Accordingly, I posit the following hypothesis:

H2c: Firm's technology competence mediates the relationship between the use of the BSC and innovation.

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4.2.3 Customer Competence

Customer competence is the ability of organizations to utilize their resources to serve customers (Danneels, 2002). Firm resources include tangible materials such as equipment or machinery and intangible materials such as the know-how and understanding of customer needs (Danneels, 2002; Grant, 1991). Specifically, Danneels (2002) provides a description of resources required for customer competence: knowledge of customer needs and processes, distribution and sales channel, communication channel, and company/brand reputation. In this study, I define the customer competence as the firm's ability to identify, understand and satisfy the customer needs.

The BSC provides a framework for integrating the strategy for value creation and also directing the organization towards its objectives (Kaplan and Norton, 2004). The customer perspective differentiates the organization by defining the value proposition for the targeted customers and building and enhancing the relationship with its customers. The customer perspective motives the organization to be customer-oriented with the intention to achieve excellence in product leadership and customer intimacy (Kaplan and Norton, 2001b). Therefore, it is likely to assume that the customer perspective encourages the development of the organizational ability to identify, understand and satisfy customer needs. The firm's orientation in the customer perspective, cultivated by the use of the BSC, fosters the development of customer competence needed for innovation.

The customer perspective links organizations to the external environment, which allows firms to understand and emphasize customers' needs (Bryant et al., 2004b). It plays an important role in achieving innovation. When identifying the success factors of new product development, Ernst (2002) argues that the market demands should be clear in new

product development. Callahan and Lasry (2004) also emphasize the importance of customer input in new product development.

It is necessary to conduct market research to understand and evaluate customer needs and analyze market potential. The dedication to the market and customer inputs throughout the entire process is the key to pursuing innovation (Ariss and Delilami, 2012). Customers' needs are the source of idea seeking for benefits such as new product features and functions. Firms need customer competence to understand customer needs. New product development only succeed when firms know what the customers want and how the firms can satisfy such needs (Danneels, 2002).

In summary, the use of the BSC provides the communication channels for firms to understand customer needs and preferences. Firms with innovation orientation tend to develop the necessary customer competence to better satisfy customer demands. Therefore, the use of the BSC enables firms to enhance customer competence, which in turn, improving firm innovation. Hence, I hypothesize that:

H2d: Firm's customer competence mediates the relationship between the use of

the BSC and innovation.

4.3 Performance Consequence for the BSC and Innovation

Prior literature provides mixed findings on the relationship between innovation and firm performance (Morgan and Berthon, 2008). Walker (2005) critically reviews 30 prior studies between 1981 and 2003 focusing on the relationship between innovation and organizational performance. All the included papers are empirical studies and directly include a dependent variable measuring organizational performance and independent variable measuring firm innovation. The research results indicate that 56% of the tests

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undertaken in the studies show a positive innovation-performance relationship while 5% indicate a negative relationship and 40% non-significant results. Therefore, the relationship between innovation and firm performance is not consistent in the existing literature.

A number of empirical studies show positive effects of innovation on a wide range of firm performance measures. Using a sample of 74 biotechnology companies in Canada, Hall and Bagchi-Sen (2002) find a positive association between innovation (measured in terms of patent applications and new product introductions) and performance (measured in terms of contract revenue growth and sales growth). Interviewing 50 firms publicly traded on Nikkei stock exchange in Tokyo, Deshpande et al. (1993) find similar results in Japanese firms. They provide evidence that the innovation, based on managers' responses to survey questionnaires (scale of 1-5) is positively related to firm performance using measures of profitability, size, market share and growth rate.

Surveying 108 Australian firms about firms' product innovation strategies, Dwyer and Mellor (1993) investigate the relationship between product innovation strategies and new product success. They find that the highest profitability in sales and overall success are in firms that adopt strategy that considers technical fit, customer needs and marketing. Additionally, these firms have the highest percentage of successful new products. Baldwin and Johnson (1996) and Salavou (2002) further reinforce the positive role of innovation as a significant determinant of firm performance. Several studies also suggest innovation as an enabler of value creation for firms aiming at sustaining competitive advantages (Subramaniam and Youndt, 2005; Teece et al., 1997). Firms with better innovation tend to respond quicker to customers' needs and achieve superior performance (Wang and Wang, 2015).

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Facing the fierce competition in the global and dynamic environment, firms utilize all kinds of firm resources to be innovative. The RBV identifies firm value stored in valuable, rare, inimitable and non-substitutable firm resources (Barney, 1991). Those firm resources enable firms to generate and sustain competitive advantage, further achieve benefits in term of financial performance such as sales growth and nonfinancial performance such as customer satisfaction. This dissertation proposes that the use of the BSC enables firms to achieve the necessary firm resources and firm competences needed for innovation.

Utilizing the national survey of identifying the trends in new product development sponsored by the Product Development & Management Association (PDMA), Barczak et al. (2009) provide suggestions for managers to improve product development method and practices. They find that firms' success in innovation depends on the improved management including project leadership, training, communication support, and customer needs identification. More importantly, the common factor among the best firms in innovation is the emphasis and integration of their innovation strategy within the firms.

The BSC acts as a framework which provides a clear picture of firms' objectives and guide operations and actions accordingly. Firms can utilize the BSC to collect information in identifying and appraising firm resources. The different but related perspectives of the BSC drives the orientation of resource allocations in the according perspectives. In addition, the BSC provides outcome-based performance measures which capture an in-depth display of firm performance. Stakeholders can enjoy a high level of information richness from the use of the BSC by utilizing the information to enhance the understanding towards organizations.

Based on the benefits of using the BSC, innovation is more likely to be successful in the firms that use the BSC because firms can better focus on innovation by having acceptances and supports across the levels of the firms. Firms can utilize the BSC as a communication device by delivering firm visions and strategies in the detailed BSC perspectives to every individual in the firms. In this way, both top managers and employees have the reference for daily operations because they understand what the firm objective is and how the firm plans to achieve the objective (Kaplan and Norton, 2001b). Therefore, I find it more convincing to propose a positive relationship between innovation for firms that use the BSC and firm performance.

The existing literature exhibits inconsistent use of performance measurement in studying innovation. Some studies utilize the traditional measures such as net income, sales and return on assets to gauge accounting performance (Corbertt, 2005; Xin et al., 2009). However, innovation by itself requires a lot of financial capital, researchers realize that it might be misleading to exclusively rely on accounting measures in examining the performance consequence of innovation. Adams et al. (2009) advocate the use of market-based measure of firm performance to avoid the potential temporary influence of negative cash flows when firms engage in costly innovation processes. Tatikonda and Montoya-Weiss (2001) conduct a survey about the integration of operations and marketing views in product innovation among the PDMA members. Based on 120 responses, they find that organizational process factors are associated with product innovation in terms of product quality and costs, which then facilitates the achievement of market outcomes such as customer satisfaction.

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In this study, I separate the accounting performance from market performance in examining the relationship between innovation for firms that use the BSC and firm performance. In order to capture the differences in performance measures, I provide detailed performance consequences of pursuing innovation from two perspectives: how firm performance benefits from innovation using accounting measures and how market investors react to firm innovation. Therefore, I hypothesize the relationships between innovation for firms that use the BSC and accounting and market performance separately as follows:

H3a: Innovation for firms that use the BSC is positively associated with accounting performance.

H3b: Innovation for firms that use the BSC is positively associated with market performance.
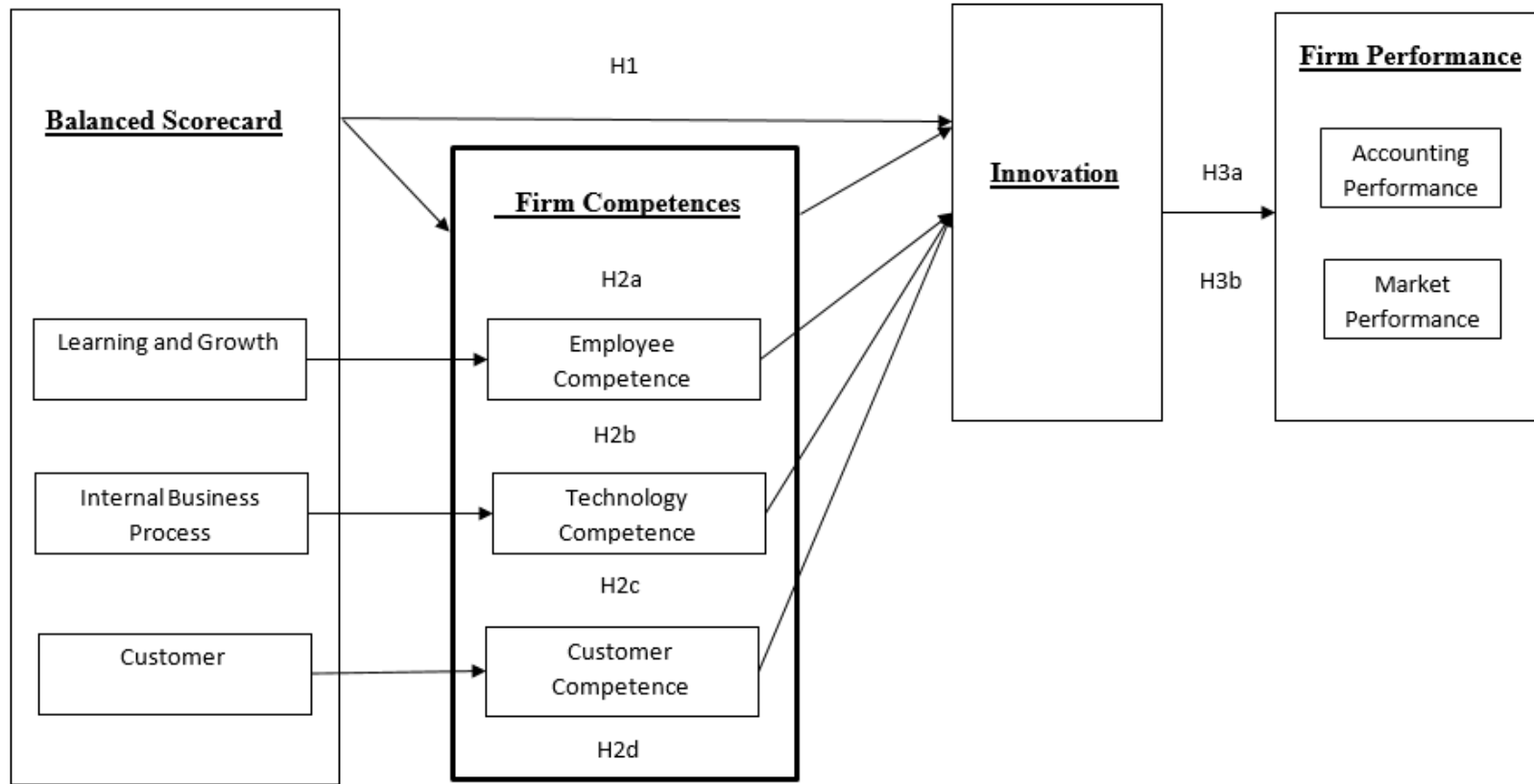
Figure 4.1 Research Model

Chapter 5

Methodology

5.1 Sample

In this study, I hypothesize that firms that use the BSC will have better innovation and this relation is mediated by firm overall competences as well as the specific employee, technology and customer perspectives. Additionally, innovation for firms using the BSC is hypothesized to be associated with accounting and market performance. Therefore, I use a diversified sample with data including firms' use of the BSC, innovation information, firm competences and firm accounting and market performance.

Following Bryant et al. (2004), I develop my sample based on the firms included in the American Society for Quality Customer Satisfaction Index (ACSI). Since its use in 1994, ACSI has been recognized as the only national measure of customer satisfaction in the United States. This index is an indicator of the satisfaction of U.S. consumers with more than 300 companies that provide products or services in 43 industries and 10

economic sectors[1], including the services of federal and local government agencies (Fornell et al., 1996).

The ACSI is available on the individual firm level which represents the evaluation of the customer experience with a specific firm; it is available on the industry level which represents the overall evaluation of the industry's market offering; and it is also available on the national level which represents the national experience (Fornell et al., 1996). Based on its percentage of sale compared to the entire industry, ASQ selects the largest companies within each industry to be included in the survey. The individual firm ACSI is identified based on approximately 250 interviews with its current customer and calculated as a weighted average of three survey measures[2] (Fornell et al., 1996).

Based on the list of companies that have ACSI scores, I search the ticker symbols for each company and identify public companies with active stock in the U.S. stock market. The initial dataset has 3,743 firm year observations (230 firms). Second, I identify whether those public companies are using the BSC by manually searching the executive compensation information in the Proxy Statements from the U.S. Security and Exchange Commission (SEC). This step results in 2,154 firm-year observations (172 firms). Last, I merge the data with the patent data from the U.S. Patent and Trademark Office (USPTO) after the necessary screening processes. I use Compustat to collect financial information

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[1] ACSI measures 10 economic sectors including 1) energy utilities, 2) health care & social assistance, 3) information, 4) transportation, 5) accommodation & food services, 6) manufacturing/durable goods, 7) finance & insurance, 8) retail trade, 9) public administration/government, 10) e-commerce and e-business ("About the American Customer Satisfaction Index", 2015).
[2] ACSI is operationalized through three survey measures: "1) an overall rating of satisfaction, 2) expectancy disconfirmation (the degree to which performance falls short of or exceeds the customers' expectations), 3) a rating of performance relative to the customer's ideal good or service in the category" (Fornell et al. 1996).

for the sample firms including employee related costs, technology investment, and the financial performance measures. I collect market performance information from the Center for Research in Security Prices (CRSP). Therefore, the final sample consists of 150 public firms (1,733 firm-year) with ASCI score, financial, nonfinancial, market, and patent data from year 1994 to 2015. The detailed sample selection procedure is presented in Table 5.1 Panel A.

Table 5.1 Panel B provides the frequency distribution of each industry by the two-digit SIC code for the 1,773 firm-year observations. Electric, Gas and Sanitary Services has the highest representation in the sample (SIC code 49, 23.01%), followed by the Food and Kindred Products (SIC code 20, 11%), and the Air Transportation (SIC code 45, 9.6%). Table 5.1 Panel C includes the frequency distribution by year. Year 2014 has the highest representation in the sample (118 firm year, 6.66%), followed by Year 2013 (110 firm year, 6.20%), and Year 2012 (104 firm year, 5.81%).

5.2 Variables Measurement

5.2.1 The Use of the Balanced Scorecard

Following Said et al. (2003), I use the company files contained in EDGAR System of the SEC to identify firms that use the BSC. Based on the sample generated from merging ASCI score with public company files, I search the annual Proxy Statements of the sample companies for keywords such as "non-financial or nonfinancial," "weight," "metric," "customer satisfaction," ''employee satisfaction or employee morale or employee motivation,'' ''quality,'' ''process improvement,'' ''re-engineering or reengineering,'' ''new product development,'' ''diversity,'' ''market share,'' ''productivity or efficiency,'' ''safety,'' ''innovation,'' ''operational measure or operational performance,'' and

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''strategic objectives.'' In order to verify the search result, I also read the Proxy Statements to confirm the existence and validity of the keywords in the file. This search process results in a sample of firm-year observations that use the BSC (including metric weight if provided in the Proxy Statements) during the sample period from 1994 to 2015 and also have ASCI score. I include a dummy variable (BSC) for the use of the BSC. BSC takes the value of 1 if the firm uses the BSC in that specific year, 0 otherwise.

5.2.2 Innovation

I define innovation as the significant improvements or developments of process, products, services or programs. Patent data is used as a measure of firm innovation in prior studies (Ahuja, 2000; Srivastava and Gnyawali, 2011). Srivastava and Gnyawali (2011) use the number of patents from the National Bureau of Economic Research (NBER) patent database to measure the breakthrough innovation. The USPTO grants patents for products and processes to the inventors with the property rights. Since patents usually go through a rigorous examination process for inventors to get awarded, the granted patents represent huge significance to the assignees. It has become standard to use the count of patents to capture firms' innovation. Therefore, I follow prior research and use the number of patents per year to measure innovation (INV). I collect patent data for each sample firm from the USPTO database (Ahuja, 2000; Srivastava and Gnyawali, 2011). In order to generate a continuous variable, I use the natural logarithm of one plus patent counts in the analysis.

5.2.3 Firm Overall Competences

Firm competences are defined as firms' abilities to successfully achieve predetermined goals in different perspectives. Prior literature uses survey questionnaire to capture individuals' perceptions of firm competences (Henderson and Cockburn, 1994;

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Luo, 1998). Since I use archival data for this dissertation, I utilize the principal component analysis to develop a composite variable for firm overall competences (FIRMCOM). The indicators include three specific competences: employee, technology and customer competence (measurement of each competence is explained in detail in the next subsections). A high FIRMCOM score represents high firm competences in general. Table 5.2 includes the factor loadings for the composite measure. The eigenvalue is 1.278, which passes the threshold of 1 as widely recognized in prior literature (Gorsuch, 1983). The Kaiser-Meyer-Olkin value is 0.50, which indicates the acceptable adequacy of the composite variable (Tabachnick and Fidell, 2001).

5.2.4 Employee Competence

Prior literature used the average wage as a proxy for human resources with the assumption that high average wage can be an indicator of a large degree of human capital (Canto and Gonzalez, 1999; Lall, 1980). Following Bryant et al. (2004), pension and retirement cost per current employee can be used as a proxy measure for the level of employee skills. It is believed that higher employee skills and competence are usually associated with higher employee benefits and compensations (Milkovich et al., 2002). Specifically, firms tend to reward skilled employees with benefits that enhance the long-term employer-employee relationships (Bryant et al., 2004). Even though this measure is not a direct measure included in the performance measurement system, Bryant et al. (2004) consider it as a reasonable proxy for employee skills and knowledge.

Therefore, I adopt the proxy measure developed by Bryant et al. (2004) in this study to measure the employee competence. Following Bryant et al. (2004), employee competence (EME) can be calculated as the pension and retirement cost without the

nonservice cost, divided by the number of employees. The adjustment of the nonservice cost includes the subtraction of the total pension cost and adding back the service cost component. I use the Compustat to collect the pension and retirement cost and number of employees for all the firm-year observations. In order to generate a continuous variable for analysis, I use the natural logarithm of pension cost divided by the number of employees to proxy for employee competence.

5.2.5 Technology Competence

Prior studies use questionnaires to collect responses about the interviewees' (usually managers or other member of top management) opinions of firms' technology competence (Ritter and Gemunden, 2004). To the best of my knowledge, no prior studies use archival data to measure technology competence. Technology competence is defined as the firms' ability to apply technology related resources including manufacturing facilities, technology know-how, and system such as Systems, Applications and Products (SAP), and Enterprise Resource Planning (ERP) in producing high-quality products/services or facilitating the management-controlled activities. Based on this definition, I use a proxy measure to capture technology competence (TECH). I include a dummy variable which takes the value of 1 if the company uses SAP, ERP, big data processing, and other high technology systems or devices in its daily operation; 0 otherwise. I use the American SAP Users' Group (ASUG) website to identify whether the company is a SAP user. ASUG is a community consisting of people and organizations with common business interests and active information sharing for more than 20 years. Moreover, I use keywords search in Proxy Statements to identify whether the firm utilizes technology related systems or devices. The keywords I used include "Software",

"Information Software", "System", "Information", "Technology", "Data", "SAP", and "ERP". In order to verify the search results, I also read the Proxy Statements to confirm the existence and validity of the keywords in the file.

5.2.6 Customer Competence

In this study, I define customer competence as the firms' ability to identify, understand and satisfy the customer needs. For companies with high customer competence, they are more likely to achieve higher customer satisfaction because they can better serve their customers. Therefore, I use customer satisfaction as a proxy measure for customer competence (CUS) in this study. Adapted from Bryant et al. (2004), ACSI score is used to measure customer satisfaction. The individual firm ACSI score is identified based on approximately 250 interviews with its current customer and calculated as a weighted average of three survey measures (Fornell et al., 1996). In order to generate a continuous variable for analysis, I use the natural logarithm of customer satisfaction score to proxy for customer competence.

5.2.7 Firm Performance

The classical measures adopted by companies to capture accounting performance include net income, sales, market share, earnings per share, return on sales and return on investments (ROI), return on assets (ROA), and return on sales growth (Corbett et al., 2005; Chen and Wong, 2004; Hall and Bagchi-Sen, 2002). As proposed in this study, I expect firm innovation benefits firms in sustaining the existing users and attracting new customers, which contributes to the company's related profitability such as revenue and gross profit. Therefore, I use ROA, calculated as gross profit divided by total assets (Baldwin and Johnson, 1996; Salavou, 2002; Yamin, et al. 1997), to measure accounting performance

(ACCT). I utilize Compustat to collect these financial data. Following Said et al. (2003), I consider the time horizon in testing the accounting performance consequences because the efficacy of innovation for firms that use the BSC may take significant time to reveal on the financial statements.

When it comes to market performance (MAR), the typical measure in prior literature includes Tobin's Q (Jose et al., 1996; Lin et al., 2006) and annualized market-adjusted stock return (Bushee and Noe, 2000; Lang and Lundholm, 1993). Because I propose that firms' innovation benefits firms in sending a positive signal to the market, which contributes to the company's market performance, I capture firms' market performance by using annualized market–adjusted returns which has become standard in the literature (Bushee and Noe, 2000; Lang and Lundholm, 1993). Similarly, I consider the time horizon in testing the market performance consequences. Annualized market adjusted stock return reflects firms' ability to generate return from stock market. It is computed by subtracting the value-weighted market return from the firm's stock return. I collect the stock data from CRSP.

5.2.8 Instrumental Variables for Innovation

Instrumental variables are used to address the potential endogeneity issue caused by the use of endogenous variables. The choice of instrumental variables relies on both the endogenous and dependent variable because the instrumental variable is correlated with the endogenous variable but not the error in the regression (Larker and Rusticus, 2010). To test the relationship between firm innovation with the use of the BSC and accounting performance, I use two instrumental variables: employee over sales (EMSALES) and industry Regulation (REG).

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Thomas et al. (1991) argue that the ratio of employees to sales represents firms'
ability to provide products and services efficiently. Ittner et al. (1997) and Said et al. (2003)
use this ratio to indicate whether the firm is a prospector because prospectors should have
a higher employee-sales ratio due to the strategic focus on innovation rather than
efficiency. Following prior literature, I also use industry regulation as instrument for
innovation (Cassiman and Martinez-Ros, 2007). Cassiman and Martinez-Ros (2007)
analyze the effects of innovation on firms' decision to export by using industry regulation
as an instrument for innovation. Regulated industries are expected to be harder to achieve
innovation due to the regulations and limitations. Therefore, I include industry regulation
(REG) as a dummy variable, which takes the value of 1 if the firm is in a regulated industry
(SIC codes 40-49), and 0 other wise (Said et al. 2003).

To test the relationship between firm innovation with the use of the BSC and market
performance, I use CEOs' innovation related education and experience (EDUEXP) as an
instrumental variable. The management literature considers an organization as a reflection
of its top managers (Hambrick and Mason, 1984). In other words, organizational strategic
choices and performance can be predicted by its managerial background characteristics.
Additionally, Hambrick and Mason (1984) suggest that a person's educational background
has significant effects on his or her values and cognitive preferences. Prior literature
includes educational background in predicting innovation (Kimberly and Evanisko, 1981).
Therefore, I include a dummy variable that indicates whether the CEO has innovation
related education and experience (EDUEXP), which takes the value of 1 if the CEO has
innovation related education (such as degree in technology, science, engineering) or
experience (worked for technology company before); 0 otherwise. To collect such

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information, I use keywords search in Proxy Statements to identify whether the CEO has innovation background. The keywords I used include "Software", "Information Software", "System", "Information", "Technology", "Data", "Innovation", and "Technology". In order to verify the search result, I also read the Proxy Statements to confirm the existence and validity of the keywords in the file. Firms with innovation strategy are expected to have top managers who have innovation related education and experience.

5.2.9 Control Variables

I control for several factors identified in the literature for their association with innovation, firm competences, and performance in order to reduce potential correlated omitted variables problems. The use of the control variables are different in the specific regression models[3].

5.2.9.1 Innovation Controls

In testing the relationship between the use of the BSC and innovation, I control for basic firm characteristics such as size, leverage, and innovation strategy. Large firms tend to have more resources and competences than small firms, so they are more likely to be involved in innovation. Firm size is measured as the natural logarithm of annual sales (LOGS) (Hirshleifer, Low, and Teoh, 2012). O'Brien (2003) examines the relationship between the capital structure and innovation. The results indicate a negative relationship between leverage and innovation. Therefore, I include leverage as a control variable for

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[3] I dropped several control variables suggested in the proposal is due to the lack of data (such as R&D intensity and adverting intensity) or multicollinearity issues (lagged innovation).

innovation. Leverage (LEV) is measured as the percentage of total debt over equity (Fama and French, 1992).

In order to test the positive relationship between the use of the BSC and innovation, it is important to consider whether the relationship is driven by other significant factors such as firm's innovation strategy[4]. A firm, which has implemented innovation strategy, is likely to achieve innovation outcomes. Therefore, it is necessary to include a variable in the model to capture whether firms have innovation strategy that drives innovation. Because such information about the innovation strategy is not publicly available, I utilize the indicators of firms using innovation strategy in order to develop a composite measure of innovation strategy (STRATEGY).

Innovation oriented firms tend to have more growth opportunities compared to less innovative firms because of better innovation outcome in terms of more attractive products or creative services. Thus, it is reasonable to expect firms with innovation strategy to have a higher market-to-book ratio. I use Tobin's Q in this study to measure the market to book ratio. Tobin's Q has been widely recognized as an indicator of market expectation of firm's long-term performance (Jose et al., 1996; Lin et al., 2006). As the ratio of firm's market value to the replacement cost of the assets, Tobin's Q reflects the market outlook of the companies' growth opportunities (Tobin, 1968). If Tobin's Q is lower than 1, it means the

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[4] I start testing the relationship between the use of the BSC and innovation with a model without innovation strategy. The coefficient of the use of the BSC is 0.147 and statistically significant at 1%. The coefficient of the use of the BSC (0.135, p=0.000) is decreased after including the innovation strategy. The decrease confirms that the innovation strategy is associated with innovation and further verify the positive relationship between the use of the BSC and innovation.

company is undervalued (i.e. the replacement cost of the firm's assets is greater than the stock value). If Tobin's Q is higher than 1, it means the company is overvalued (i.e. the stock value is more than the replacement cost of the assets). Jose et al. (1996) argue that the Tobin's Q-ratio reflects both the intangible and tangible assets. Lin et al (2006) identify that Tobin's Q can be a proxy measures of firm's intangible capital and also be used to evaluate the corporate strategy involving the investment decisions. Tobin's Q is calculated as the ratio of the firm's market value of equity to the firm's book value of equity (Jose, 2009). The market value of firm equity is calculated as the closing price at year end (December 31) multiplied by the number of common share outstanding. In order to generate a continuous variable, I use the natural logarithm of Tobin's Q-ratio in the analysis. I obtain the book value of firm's equity from Compustat and the stock price data from CRSP.

Firms are more likely to have superior working facilities in terms of plant, property and equipment (PPE) when adopting an innovation strategy. Therefore, innovative firms are expected to have high PPE. Following Thomas et al, (1991) and Said et al (2003), I include the ratio of employees to sales to represent the efficiency to provide and distribute the goods and services. Innovation oriented firms are expected to have a high ratio of employees to sales, indicating that efficiency is not their strategic priority. Large firms are more likely to have innovation orientation because of the availability of firm resources compared to small firms (O'Brien, 2003). Specifically, large firms are expected to adopt innovation strategy. Therefore, I include size in the innovation strategy composite and measure it as the natural logarithm of annual sales. As discussed earlier, managers' background influences his or her values and preferences, which further influences

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organizational strategic choices. Therefore, I include EDUEXP to proxy for the possibility that the CEO might adopt the innovation strategy. EDUEXP is dummy variable, which takes the value of 1 if the CEO has innovation related education (such as degree in technology, science, engineering) or experience (worked for technology company before); 0 otherwise. The detailed measurements are explained in the previous subsection.

I use the principal component analysis to construct a composite measure of STRATEGY based on the determinants discussed as above. The indicators of innovation strategy include: (1) the market-to-book ratio, (2) natural logarithm of net plant, property, and equipment, (3) the ratio of employee to sales, (4) natural logarithm of firm assets, and (5) CEO's innovation related education and experience. A high STRATEGY score represents firms' adoption of innovation strategy. Table 5.3 includes the details of the factor loadings. The eigenvalue is 1.838, which passes the threshold of 1 as widely recognized in prior literature (Gorsuch, 1983). The Kaiser-Meyer-Olkin measure returns a 0.5477 value, which indicates the acceptable adequacy of the composite variable (Tabachnick and Fidell, 2001).

5.2.9.2 Firm Competences Controls

In testing the relationship between the use of the BSC and firm competences, I control for factors that are reported to affect firm competences. Specifically, I control for size, capital structure, and investment in working facilities. Firm competences are related to firm size because large firms tend to have better collection of resources that are needed for firm competences. Firm size is measured as the natural logarithm of annual sales (LOGS) (O'Brien, 2003). Following Hirshleifer, Low and Teoh (2012), I include leverage (LEV) as a control variable for firm competences, measured as the percentage of total debt

over equity (Fama and French, 1992). Firms' capital structure is related to firm competence because firms with heavy debt repayment obligations tend to have less capital to invest in firm competence development. Another control variable for firm competences is LPPEE, a natural logarithm of net plant, property, and equipment divided by number of employees (Hirshleifer et al., 2012). LPPEE is a measure of firms' investment in tangible assets, which is a determinant of competence development.

5.2.9.3 Performance Controls

In testing the performance consequences of firms that use the BSC to achieve innovation, I control for factors that are reported to affect firm performance. Specifically, I control for size, investment in working facilities, leverage, volatility and lagged performance. Large firms tend to have more revenue sources than small firms, so they are more likely to have better firm performance (Bryant et al. 2004). I include the control variable of annual sales (LOGS), which is measured as the natural logarithm of annual sales (O'Brien, 2003). Additionally, firms with an orientation to provide superior working facilities tend to achieve better performance because of the availability of necessary tangible assets. Following Hirshleifer, Low and Teoh (2012), I also include LPPEE, the natural logarithm of net plant, property, and equipment divided by number of employees to control for firms' investments in working facilities.

Furthermore, firms with high leverage tend to experience changes in accounting performance, so I measure leverage (LEV) as the percentage of total debt over equity (Fama and French, 1992). Volatility indicates the changes in the firm performance, which relates closely with firm performance (Jeter and Chaney, 1992; Warfield et al. 1995). Therefore, I control for accounting performance volatility (ACCV) and market

performance volatility (MARV). ACCTV is measured as the standard deviation of ROA over the previous 2 years, while MARV is measured as the standard deviation of annualized daily stock returns over the previous 2 years. In addition, I include lagged accounting performance ($ACCT_{it-1}$) and lagged market performance (MAR_{it-1}) to control for the past performance (Said et al., 2003).

5.3 Empirical Models

The observations in this study are organized at more than one level (i.e. year, company and industry), so the data is nested. I use multilevel regression to recognize the existence of the data hierarchy (Gelman and Hill, 2007). Multilevel models are used in the first 2 sets of hypotheses. The effects of year and industry are held fixed as well. Due to the endogeneity issue, I use two Stage Least Squares (2SlS) to test the last two hypotheses.

5.3.1 The BSC and Innovation

The first hypothesis posits (H1) that the use of the BSC is positively associated with firm innovation. To test H1, I regress innovation on the use of the BSC, and control variables identified in prior studies and discussed earlier. The model is specified as follows:

$$INV_{it} = \alpha_{10} + \beta_{11}BSC_{it} + \beta_{12}REG + \beta_{13}LOGS_{it} + \beta_{14}LEV_{it} + \beta_{15}STRATEGY_{it}$$
$$+ Industry\ Fixed\ Effects + Year\ Fixed\ Effects + e_{10} \qquad (1)$$

Where INV is the dependent variable representing innovation, BSC is the independent variable representing the use of the BSC, REG is the instrument of innovation which represents the industry regulation. The model also includes three control variables:

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LOGS represents firm size, LEV represents leverage, and STRATEGY represents firm's possibility of having innovation strategy. $Industry\ Fixed\ Effects$ and $Year\ Fixed\ Effects$ are included in the model to hold the variation in the industries and years fixed. Following the first hypothesis development, I expect β_{11} to be positive given that the use of the BSC is expected to be positively associated with innovation.

5.3.2 The Mediating Role of Firm Competences on the Relation between the BSC and Innovation

In order to explore the role of firm competences on the relation between the use of the BSC and innovation, I use factor analysis to develop a composite variable for firm competences (FIRMCOM) with three indicators including employee, technology and customer competence. I also investigate the effects of the specific perspectives of firm competences: employee, technology and customer. The second set of hypotheses posits that the relationship between the use of the BSC and innovation is mediated by the overall firm competences (H2a), including employee competence (H2b), technology competence (H2c) and customer competence (H2d). Following Baron and Kenny (1986) and Zhao et al. (2010), the models to test the mediation of three firm competences are listed below. The general mediation model is illustrated in figure 5.1. The first set of models (2a, 2b, 2c, and 2d) test the relationship between the predictor variable (the use of the BSC) and the mediating variable (overall firm competences, employee competence, technology competence and customer competence).

$$FIRMCOM_{it} = \alpha_{20} + \beta_{21}BSC_{it} + \beta_{22}LOGS_{it} + \beta_{23}LEV_{it} + \beta_{24}LPPEE_{it}$$
$$+ Industry\ Fixed\ Effects + Year\ Fixed\ Effects + e_{20} \qquad (2a)$$

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$$EME_{it} = \alpha_{30} + \beta_{31}BSC_{it} + \beta_{32}LOGS_{it} + \beta_{33}LEV_{it} + \beta_{34}LPPEE_{it}$$
$$+ Industry\ Fixed\ Effects + Year\ Fixed\ Effects + e_{30} \qquad (2b)$$

$$TECH_{it} = \alpha_{40} + \beta_{41}BSC_{it} + \beta_{42}LOGS_{it} + \beta_{43}LEV_{it} + \beta_{44}LPPEE_{it}$$
$$+ Industry\ Fixed\ Effects + Year\ Fixed\ Effects + e_{40} \qquad (2c)$$

$$CUS_{it} = \alpha_{50} + \beta_{51}BSC_{it} + \beta_{52}LOGS_{it} + \beta_{53}LEV_{it} + \beta_{54}LPPEE_{it}$$
$$+ Industry\ Fixed\ Effects + Year\ Fixed\ Effects + e_{50} \qquad (2d)$$

Where FIRMCOM, EME, TECH and CUS are the mediating variables representing the firm overall competences, employee competence, technology competence and customer competence, respectively, and BSC is the independent variable representing the use of the BSC. The models include control variables for competences: LOGS represents size, LEV represents leverage, and LPPEE represents firms' investment in working facility per employee. $Industry\ Fixed\ Effects$ and $Year\ Fixed\ Effects$ are included in the models to control for the variations in industries and years.

The second set of models (3a, 3b, 3c and 3d) test the mediating effect of overall firm competences, and its three specific perspectives (employee competence, technology competence and customer competence) on the use of the BSC and innovation as follows:

$$INV_{it} = \alpha_{60} + \beta_{61}BSC_{it} + \beta_{62}FIRMCOM_{it} + \beta_{63}LOGS_{it} + \beta_{64}LEV_{it} + \beta_{65}STRATEGY_{it}$$
$$+ Industry\ Fixed\ Effects + Year\ Fixed\ Effects + e_{60} \qquad (3a)$$

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$$INV_{it} = \alpha_{70} + \beta_{71}BSC_{it} + \beta_{72}EME_{it} + \beta_{73}LOGS_{it} + \beta_{74}LEV_{it} + \beta_{75}STRATEGY_{it}$$
$$+ \text{Industry Fixed Effects} + \text{Year Fixed Effects} + e_{70} \qquad (3b)$$

$$INV_{it} = \alpha_{80} + \beta_{81}BSC_{it} + \beta_{82}TECH_{it} + \beta_{83}LOGS_{it} + \beta_{84}LEV_{it} + \beta_{85}STRATEGY_{it}$$
$$+ \text{Industry Fixed Effects} + \text{Year Fixed Effects} + e_{80} \qquad (3c)$$

$$INV_{it} = \alpha_{90} + \beta_{91}BSC_{it} + \beta_{92}CUS_{it} + \beta_{93}LOGS_{it} + \beta_{94}LEV_{it} + \beta_{95}STRATEGY_{it}$$
$$+ +\text{Industry Fixed Effects} + \text{Year Fixed Effects} + e_{90} \qquad (3d)$$

Where INV is the dependent variable representing innovation, FIRMCOM, EME, TECH and CUS are the mediating variable representing the firm overall competences, employee competence, technology competence and customer competence, respectively, and BSC is the independent variable representing the use of the BSC. The models also include control variables for innovation: LOGS represents firm size, LEV represents leverage, and STRATEGY represents firms' innovation strategy.

I expect partially mediating effects in this study because prior literature confirms that it is rare to find fully mediating effects in social science studies (Baron and Kenny, 1986). In order to test the mediating effect, first of all, I confirm the direct relationship between the use of the BSC and firm innovation (H1). The positive coefficient of the first hypothesis shows statistical positive significance. Next step is to test the relationship between the use of the BSC (predictor variable) and firm competences (mediating variable). Again, a significant positive coefficient needs to be determined between these two variables. The signs for β_{21}, β_{31}, β_{41} and β_{51} are expected to be positive. Last, I

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regress firm competences on the use of the BSC and innovation to test the mediating effects of firm competences in general as well as the three specific perspectives including employee, technology and customer competence. Therefore, $\beta_{61}, \beta_{71}, \beta_{81}, \beta_{91},\ \beta_{62}, \beta_{72}$ β_{82}, β_{92} need to be significantly positive in models 3a, 3b, 3c and 3d.

5.3.3 Firm Performance Consequences

The last set of hypotheses investigates the performance consequences of innovation for firms using the BSC. Specifically, I examine whether innovative firms that use the BSC perform well in terms of accounting and market performance. Hypothesis 3a posits that innovation for firms that use the BSC is positively associated with accounting performance. Hypothesis 3b posits that innovation for firms that use the BSC is positively associated with market performance. Because the factors that cause changes in firm innovation might also affect firm performance, it is likely that there is an endogeneity issue in the performance models.

Larcker and Rusticus (2010) suggest that the solution to endogeneity issue is to include an instrumental variable that is correlated with the endogenous variable but not correlated with the error in the regression. Therefore, I use different instruments for innovation in testing the accounting and market performance consequence. To investigate the relationship between innovation with the use of the BSC and accounting performance, I include the use of the BSC (BSC) as independent variable, firms' efficiency in providing the goods and services (EMSALES) and industry regulation (REG) as the instrumental variable. Similarly, I use instruments including CEOs' innovation related education and experience (EDUEXP) and industry regulation (REG) to investigate the market performance consequences of firms using the BSC to achieve innovation. Two Stage Least

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Squares (2 SLS) is used to test this set of hypotheses. The first stage should only include exogenous variables if the purpose of using 2SLS is to address the endogeneity issue (Larcker and Rustcus, 2010). Therefore, the first stage regresses the innovation on the use of the BSC and innovation instruments.

Stage 1:

$$INV_{it} = \alpha_{s10} + \beta_{s11}BSC_{it} + \beta_{s12}EMSALES_{it} + \beta_{s13}REG_{it} + e_{s10} \qquad (4a)$$

$$INV_{it} = \alpha_{s20} + \beta_{s21}BSC_{it} + \beta_{s22}EDUEXP_{it} + \beta_{s23}REG_{it} + e_{s20} \qquad (4b)$$

The second-stage regression tests the relationship between innovation and firm performance, where innovation is the residuals from the first-stage regression[5]. The second stage models for performance are as follows:

Stage 2:

$$ACCT_{it} = \alpha_{s30} + \beta_{s31}INV_{HAT_{it}} + \beta_{s32}LOGS_{it} + \beta_{s33}LEV + \beta_{s34}LPPEE_{it} +$$
$$\beta_{s35}ACCTV_{it} + \beta_{s36}ACCT_{it-1} + e_{30} \qquad (4c)$$

$$MAR_{it} = \alpha_{s40} + \beta_{s41}INV_{HAT_{it}} + \beta_{s42}LOGS_{it} + \beta_{s43}LEV_{it} + \beta_{s44}LPPEE_{it} +$$
$$\beta_{s45}MARV_{it} + \beta_{s46}MAR_{it-1} + e_{s40} \qquad (4d)$$

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[5] Following Heij et al. (2004), the idea to use the residuals from the first stage is to replace explanatory variable (INV) by linear combinations of instrumental variables that approximate INV as well as possible.

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Where ACCT represents the accounting performance and MAR represents market performance, INV_HAT represents the residuals from the first-stage regressions (4a and 4b). Following Said et al. (2003), I consider the time horizon in examining the innovation-performance relationship. Specifically, I investigate the relationship between innovation and current performance (current year t) as well as future performance (year t+5 and year t+10). The models also include control variable for performance: LOGS represents firm size, LEV represents leverage, and LPPEE represents firms' investment in working facility, ACCTV represents accounting performance volatility, MARV represent market performance volatility, $ACCT_{it-1}$ is the lagged accounting performance in year t-1, and MAR_{it-1} is the lagged market performance in year t-1. I expect innovation for firms that use the BSC to be positively associated with firm performance. Therefore, the expected signs for $\beta_{s11}, \beta_{s21}, \beta_{s31} \beta_{s41}$ are positive. I use Hausman test to identify endogeneity in the performance models (Hausman, 1978) and also test for overidentifaction to check whether the models are correctly specified (Cragg and Donald, 1993).

Table 5.1 Panel A: Sample Selection Procedures

	Number of Firm-year	Number of Firms
Initial dataset of pubic firms from ASUG database during 1994-2015	3,743	230
Exclude: Missing Proxy statements needed for the identification of the use of the BSC	(1,589)	(58)
	2,154	172
Exclude: Other missing information	(381)	(22)
Final observations	**1,773**	**150**

Table 5.1 Panel B: Frequency Distribution of Industry Firm-year Observations

Industry	SIC	# of observation	% of sample
Food and Kindred Products	20	195	11%
Tobacco Products	21	12	0.68%
Textile Mill Products	22	7	0.39%
Apparel & Other Textile Products	23	37	2.09%
Publishing & Printing	27	4	0.23%
Chemicals & Allied Products	28	57	3.21%
Petroleum & Coal Products	29	14	0.79%
Rubber & Plastics Footwear	30	21	1.18%
Industrial & Machinery Equipment	35	22	1.24%
Electronic & Other Electrical Equipment	36	51	2.88%
Transportation Equipment	37	18	1.02%
Trucking & Warehousing	42	17	0.96%
Air Transportation By Air	45	108	6.09%
Transportation Services	47	11	0.62%
Communications	48	95	5.36%
Electric, Gas & Sanitary Services	49	408	23.01%
Building Materials & Garden Supplies	52	28	1.58%
General Merchandise Stores	53	96	5.41%
Food Stores	54	34	1.92%
Apparel & Accessory Stores	56	33	1.86%
Furniture & Homefurnishings Stores	57	14	0.79%
Eating & Drinking Places	58	78	4.4%
Miscellaneous Retail	59	7	0.39%
Depository Institutions	60	61	3.44%
Nondepository Institutions	61	9	0.51%
Security & Commodity Brokers	62	39	2.2%
Insurance Carriers	63	84	4.74%
Hotels & Other Lodging Places	70	42	2.37%
Business Services	73	86	4.85%
Motion Pictures	78	8	0.45%
Engineering & Management Services	87	22	1.24%
Total		**1,773**	**100%**

Table 5.1 Panel C: Frequency Distribution by Year

Year	Number of Firm-year	Percentage of Sample
1994	50	2.82%
1995	54	3.05%
1996	55	3.10%
1997	54	3.05%
1998	54	3.05%
1999	54	3.05%
2000	63	3.55%
2001	75	4.23%
2002	73	4.12%
2003	75	4.23%
2004	79	4.46%
2005	85	4.79%
2006	91	5.13%
2007	103	5.81%
2008	99	5.58%
2009	102	5.75%
2010	103	5.81%
2011	103	5.81%
2012	104	5.87%
2013	110	6.20%
2014	118	6.66%
2015	69	3.89%
Total	**1,773**	**100%**

Table 5.2: Principal Component Analysis for Overall Firm Competences

Component	Loadings	Kaiser-Meyer-Olkin Measure
EME	0.7068	0.4991
TECH	0.696	0.4990
CUS	-0.1269	0.4704
Eigenvalue	1.278	
Overall Composite variable		0.50

Note: Refer to Appendix A for variable definitions and measurements.

Table 5.3: Principal Component Analysis for Innovation Strategy

Component	Loadings	Kaiser-Meyer-Olkin Measure
Tobin's Q	-0.0906	0.6948
LPPE	0.5698	0.5213
EMSALE	-0.4071	0.6213
LOGTA	0.2959	0.5313
EDUEXP	0.6433	0.6476
Eigenvalue	1.838	
Overall Composite Variable		0.5477

Note: Refer to Appendix A for variable definitions and measurements.

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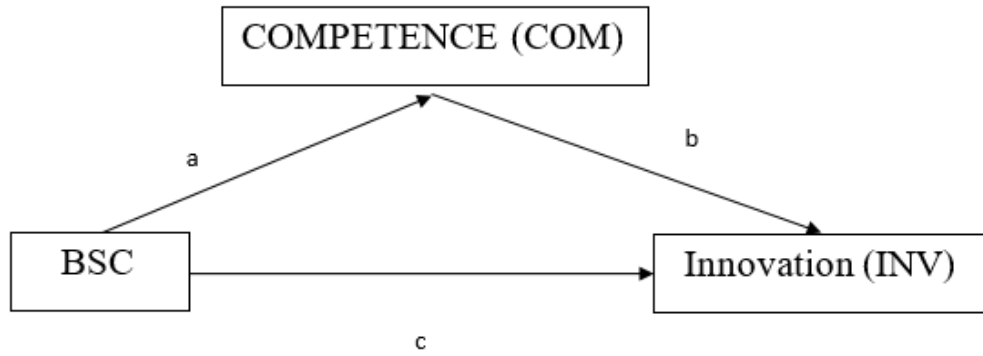
Figure 5.1 Mediation Model

Chapter 6

Results and Discussion

6.1 Sample Description

Table 6.1 includes the descriptive statistics and univariate analysis for the sample firms. Panel A presents the descriptive statistics for all of the main variables in the final sample. The mean of the use of the BSC is 0.522, which represents 52.25 % of the observations use the BSC. The mean of the natural logarithm of the number of patents is 0.561, which represents an average of 3.6 patents for each observation. The composite variable of firm overall competences has a mean close to 0, and a median of 0.22. Employee competence has a mean of 0.287 and is close to the median of 0.337. The mean of technology competence is 0.686, meaning that 68.6% of the observations have technology competence. The mean for the customer competence is 1.88 and is very close to the median of 1.886. Accounting performance has a mean of 0.305 and a median of 0.252. Similar statistics can be found for market performance with a mean of 0.433 and a median of 0.361. All variables can be considered as normally distributed because the skewness is close to 0 and kurtosis is around 3 (Joanes and Gill, 1998). The descriptive statistics are consistent with the prior literature which uses the same database (Bryant et al, 2004).

Panel B includes the univariate analysis, which is the descriptive statistics of variables under investigation partitioned by the use of the BSC. The sample contains 978 firm-year observations that use the BSC, and 795 observations that do not use the BSC. Firms using the BSC tend to have, on average, better performance than firms that do not use the BSC in all aspects including innovation, firm overall competence, employee competence, technology competence, and market performance.

I run an independent sample T-test and the Kolmogorov-Smirnov Z test to identify whether the means of the two subgroups (firms that use the BSC and firms that do not use the BSC) are statistically different from each other. The results of the independent sample T-test indicate significant differences between firms that use the BSC and firms that do not use the BSC in all variables except the customer competence (CUS) and accounting performance. Additionally, the results of the Kolmogorov-Smirnov Z test draw the same conclusions.

Table 6.2 contains Pearson correlations between the use of the BSC, competences, innovation, performance, and control variables used in this analysis. The results indicate significant correlations between the variables of interest without multicollinearity concerns. Specifically, the correlation between BSC and TECH is 0.459 and statistically significant at 1%, indicating a positive correlation between them. The correlation between EME and INV is 0.136 and statistically significant at 1% level, showing a positive relationship between them. The other two competences are significantly correlated to innovation as well. Additionally, INV significantly correlates with FIN (0.171, p-value=0.000) and MAR (0.241, p-value=0.000).

Additionally, I test for multicollinearity using the Variance Inflation Factor (VIF). Prior literature recommends different acceptable levels of VIF. Most commonly, a value of 10 has been recognized as the acceptable maximum level of VIF (Hair, Anderson, Tatham, and Black, 1995) and recently a maximum value of 5 has been recognized as a more appropriate indicator of multicollinearity (Rogerson, 2001). I use the value of 5 as the threshold for multicollinearity in this study and find no indication of multicollinearity.

6.2 Results

This study examines whether the use of the BSC is associated with innovation. Additionally, it explores the role of the overall firm competences and the three specific perspectives including employee, technology and customer competence in the relation between the use of the BSC and innovation. Moreover, this dissertation investigates the performance consequence of pursuing innovation for firms that use the BSC. The tests provide empirical evidences to all the hypotheses using the specific estimation models based on the prior literature in econometrics.

6.2.1 Results of the Relation between the Use of the BSC and Innovation

Hypothesis 1 states that the use of the BSC is positively associated with innovation. To test Hypothesis 1, I regress innovation on the use of the BSC, industry regulation, and the three control variables (LOGS, LEV and STRATEGY). As discussed in the methodology, it is necessary to consider the innovation strategy in testing the relationship between the use of the BSC and innovation.

Table 6.3 shows the regression results of innovation and the use of the BSC. Overall, the model for testing hypothesis 1 has a good fit with data and is statistically

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significant, with an adjusted R^2 of 63.92%. The model does not indicate a multicollinearity issue because the average VIF is 1.62. Additionally, no variable has a VIF value more than 5 (Rogerson, 2001). Using multilevel regression and holding industry and year level effects fixed, the estimated coefficient of the use of the BSC is 0.135 and significant at the 1% level. (p<0.000). Additionally, innovation strategy has a positive coefficient of 0.056 and significant at 10% level (p=0.069).

Therefore, hypothesis 1 is strongly supported. In other words, the use of the BSC is likely to play a positive role in facilitating firms to achieve better innovation, consistent with the survey responses in prior studies (Jarrar and Smith, 2011; Wu, 2012; Mohamed, 2013). This study contributes to the existing literature by providing empirical evidence on the relationship between the use of the BSC and innovation using archival data rather than drawing conclusions based on managers' perceptions.

6.2.2 Results of the Mediating Effects of Firm Competences

The second set of hypotheses expects that firm s' overall competences, as well as the specific employee, technology and customer competences mediate the relationship between the use of the BSC and firm innovation. I start by testing H2a whether the overall firm competences have a mediating effect on the relationship between the use of the BSC and innovation using the composite variable of firm competences. Table 6.4 Panel A shows a positive (0.747) and statistically significant (p-value=0.000) relationship between the use of the BSC and overall firm competences. It confirms the positive path from the predicting variable to the mediating variable.

Table 6.4 Panel B indicates a positive and significant (0.096, p-value=0.006) relationship between the use of the BSC and innovation, and a significantly positive and

relationship (0.057, p-value=0.000) between the overall firm competences and innovation as well. Overall, the models have a good fit with data, with an adjusted R^2 of 37.55% and 63.53%. Both models do not indicate a multicollinearity issue because the average VIF is 1.02 and 1.97, respectively, and no variable has a VIF value more than 5 (Rogerson, 2001). Therefore, H2a is supported. Prior literature only shows a positive association between the firm competences and innovation (Junkunc, 2007; Rubera et al. 2012; Siguaw et al. 2006). This study enhances the understanding of the firm competences and innovation by including the effects of strategic management control system (the use of the BSC) on achieving firm competences, and further benefiting innovation.

H2b states that firm's employee competence mediates the relationship between the use of the BSC and innovation. Table 6.4 Panel A shows a positive (0.1) and statistically significant (p-value=0.001) relationship between the use of the BSC and firm's employee competence. The path from innovation (the predictor variable) to employee competence (the mediating variable) is confirmed to be positive. Table 6.4 Panel B indicates a positive and significant (0.129, p-value=0.000) relationship between the use of the BSC and innovation. Additionally, the coefficient between employee competence and innovation is significantly positive (0.077, p-value=0.002) indicating that employee competence mediates the relationship between the use of the BSC and innovation. Overall, the models for testing hypothesis H2b have a good fit with data, with an adjusted R^2 of 45.37% and 63.75%. Both models do not indicate a multicollinearity issue because the average VIF is 1.02 and 1.71, respectively, and no variable has a VIF value more than 5 (Rogerson, 2001). Therefore, H2b is supported. Prior studies have confirmed the importance of employee competence in innovation related activities Canto and Gonzalez, 1999; Junkunc, 2007).

This study builds on the prior finding and supports the mediating role of employee competence in the relationship between the use of the BSC and innovation with empirical archival evidence.

According to H2c, firm's technology competence mediates the relationship between the use of the BSC and innovation. Table 6.4 Panel A shows a positive (0.423) and statistically significant (p-value=0.000) relationship between the use of the BSC and firm's technology competence. It confirms the positive path from innovation (the predicting variable) to technology competence (the mediating variable). Table 6.4 Panel B indicates a positive and significant (0.097, p-value=0.007) relationship between the use of the BSC and innovation. More importantly, the coefficient between technology competence and innovation is positive and significant at the 1% (0.09, p-value=0.004). The results indicate that technology competence mediates the relationship between the use of the BSC and innovation.

Overall, the models for testing hypothesis H2C are statistically significant, with an adjusted R^2 of 32.99% and 63.66%. Both models do not indicate a multicollinearity issue because the average VIF is 1.02 and 1.66, respectively, and no variable has a VIF value more than 5 (Rogerson, 2001). Therefore, H2c is supported and is consistent with prior research related to innovation and technology competence (Ariss and Deilami, 2012; Danneels, 2003). This study builds on the prior finding and supports the mediating role of technology competence in the relationship between the use of the BSC and innovation with empirical archival evidence.

H2d states that firm's customer competence mediates the relationship between the use of the BSC and innovation. Table 6.4 Panel A shows a positive (0.004) and statistically

significant (p-value=0.027) relationship between the use of the BSC and firm's customer competence. It confirms the positive path from innovation (the predicting variable) to customer competence (the mediating variable). Table 6.4 Panel B indicates a positive and significant (0.139, p-value=0.007) relationship between the use of the BSC and innovation. Moreover, the coefficient between customer competence and innovation is positive and significant at the 10% level (0.723, p-value=0.099), which indicates that customer competence mediates the relationship between the use of the BSC and innovation. Overall, the models for testing hypothesis H2d are statistically significant, with an adjusted R^2 of 46% and 64.66%. Both models do not indicate a multicollinearity issue because the average VIF is 1.02 and 1.54, respectively, and no variable has a VIF value more than 5 (Rogerson, 2001). Therefore, H2d is supported. The results are consistent with prior literature suggesting the critical role of customer competence in pursuing innovation in general (Callahan and Lasry, 2004; Ernst 2002). This study adds to the existing literature on the role of customer competence on innovation by adding the mediating effects of customer competence in the relationship between the use of the BSC and innovation. Specifically, the evidence provided show how the use of the BSC as a strategic vehicle can achieve the resources and competences needed for innovation.

6.2.3 Results of the Performance Consequences

According to the third set of hypotheses state that innovation in firms that use the BSC is expected to be positively associated with firm performance in terms of accounting and market performance. Because innovation might be endogenous, in addition to Ordinary Least Square (OLS), I use two Stage Least Squares (2 SLS) to address the potential

endogeneity issue, and use different innovation instruments in each performance regression. Following prior literature, I use instruments including the employee-to-sales ratio which reflects the efficiency in providing products and services (Said et al, 2003; Thomas et al. 1997) and industry regulation (Cassiman and Martinez-Ros, 2007) in the accounting performance regression. For market performance, I use CEOs' innovation related background (Hambrick and Mason, 1984; Kimberly and Evanisko, 1981), and industry regulation (Cassiman and Martinez-Ros, 2007) as instruments for innovation.

Following Said et al (2003), I realize it is crucial to take the time frame into the consideration of the innovation-performance relationship. The effects of innovation may take substantial time to reveal in performance as innovation involves long-term commitment. Therefore, I investigate the relationship between innovation and current performance (current year t) as well as future performance (year t+5 and year t+10).

Table 6.5 Panel A includes the results of OLS regression for accounting performance consequences. The results indicate a positive and significant relationship between innovation and future accounting performance (0.047, p-value=0.000; 0.057, p-value=0.000). However, innovation is negatively associated with current accounting performance (-0.004, p-value=0.058). The mixed findings further verify the need of considering time horizon in the relationship between innovation and accounting performance. It implies that innovation is costly and firms might not capture the positive financial impacts instantly but in the long term. To address the potential endogeneity issue, I adopt 2SLS by using instruments to represent innovation in the first stage regression. The second stage regression tests the relationship between firm innovation and firm performance, where innovation is the residuals from the first stage regression.

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As shown in Table 6.5 Panel B, the first stage regressions confirm the positive relationship between the use of the BSC and innovation in the current and future performance models (0.190, p-value=0.000; 0.245, p-value=0.000; 0.296, p-value=0.000). The models have an acceptable fit with the data, with an adjusted R^2 of 27.19%, 28.78% and 34.37%. The positive and statistically significant F statistics (83.435, p-value=0.000; 76.50, p-value=0.000; 57.794, p-value=0.000) indicate that the instruments are strong and valid (Godfrey, 1992).

Table 6.5 Panel C shows the second stage regression results. Using ROA as the dependent variable, the coefficient of innovation is positive but insignificant in current year t (0.0002, p-value=0.962), which indicates that firm innovation is not significantly associated with current accounting performance. However, the innovation-accounting performance relationship is positive and statistically significant in year t+5 and Year t+10 (0.177, p-value=0.000; 0.152, p-value=0.000). These results suggest that innovation is positively associated with future accounting performance. It implies that the use of the BSC help firm to be innovative but it takes time for firms to start recognizing the effects on the financial statement. The models do not indicate a multicollinearity issue because the average VIF is 1.11, 1.03 and 1.03, respectively. No variable has a VIF value more than 5 (Rogerson, 2001).

As prior literature presents mixed findings in the innovation-performance relationship, it is not surprising to find an insignificant relationship between firm innovation and current accounting performance in this test. The majority of innovation studies confirm a significant and positive relationship between innovation and firm's accounting performance (Barczak et al., 2009; Dwyer and Melloe, 1993; Hult and Ketchen,

2001; Hall and Bagchi-Sen, 2002). However, it is not rare to report negative or insignificant results in testing the innovation-performance relationship (Baldwin and Johnson,1996; Subramanian and Nilakanta, 1996; Garg, Walters and Priem, 2003). Additionally, researchers find that different innovation types have different effects on organizational performance (Damanpour, Walker and Avellaneda, 2009). Therefore, it is likely that the negative relationship between firm innovation and current accounting performance is a result of different innovation types in this study. Future research can look into the innovation types and explore a detailed innovation-performance relationship.

The Hausman tests of the residuals from OLS and 2SLS report significant chi squares for current and future performance models (109.71, p-value=0.000; 61.73, p-value=0.000; 30, p-value=0.000). It indicates that the differences between the two methods are statistically significant. In other words, the estimates provided by OLS are not consistent, which verifies the need of using 2 SLS in testing the accounting performance consequences (Hausman, 1978; Larcker and Rusticus, 2010). The tests of over-identifying restrictions report a positive and insignificant Basmann Chi square in current year t (0.854, p-value=0.653) and year t+10 (1.309, p-value=0.520) indicating that the instrument set is valid and the models are correctly specified for current year and year t+10 (Cragg and Donald, 1993). Therefore, H3a is partially supported for future performance. Innovation for firms that use the BSC is significantly and positively associated with future accounting performance but not current accounting performance.

H3b states that firm innovation is positively associated with firm's market performance. I test the relationship between innovation and market performance using OLS. As shown in Table 6.6 Panel A, the results indicate a positive and significant

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relationship between innovation and current market performance (0.143, p-value=0.000). Additionally, innovation is positively associated with future market performance as well (0.147, p-value=0.000; 0.136, p-value=0.000).

The results of 2 SLS for market performance are shown in Table 6.6 Panel B and Panel C. The first stage regressions confirm the positive relationship between the use of the BSC and innovation in the current and future performance models (0.087, p-value=0.074; 0.129 p-value=0.019; 0.142, p-value=0.029). The models have an acceptable fit with the data, with an adjusted R^2 of 26.89%, 29.57%, and 36.08%. The positive and statistically significant F statistics (76.282, p-value=0.000; 82.49, p-value=0.000; 66.147, p-value=0.000) indicate that the instruments are strong and valid (Godfrey, 1992).

The coefficients in Table 6.6 Panel C suggest a positive and statistically significant relationship between innovation and current as well as future market performance (0.028, p-value=0.06; 0.249, p-value-=0.000; 0.220, p-value=0.000). Therefore, H3b is supported, indicating innovation for firms that use the BSC is positively associated with market performance contemporaneously and prospectively. The models do not indicate a multicollinearity issue because the average VIF is 1.06, 1.05 and 1.03, respectively. No variable has a VIF value more than 5 (Rogerson, 2001).

The Hausman tests report significant chi squares for current and future market performance models (33.34, p-value=0.000; 12.24, p-value=0.000; 6.52, p-value=0.000,). It verifies the need of using 2 SLS in testing the market performance consequences (Hausman, 1978; Larcker and Rusticus, 2010). The tests of over-identification report positive and insignificant Basmann Chi squares (1.894, p-value=0.388; 5.165, p-value=0.176) in current market performance (t) and future market performance (t+5)

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indicating that the instrument set is valid and the models are correctly specified for the current year and year t+5 (Cragg and Donald, 1993).

In summary, all hypotheses are supported except H3a which posits a positive relationship between innovation in firms that use the BSC and accounting performance. A positive relationship only exists between innovation and future accounting performance but not current accounting performance. The summary of hypotheses testing can be found in Table 6.7. The results provide empirical evidence supporting the positive relationship between the use of the BSC and innovation. Firms that use the BSC tend to be more innovative. In addition, the results confirm the mediating role of the overall firm competences as well as the three specific competence perspectives, including employee, technology and customer, on the relation between the use of the BSC and innovation. This dissertation indicates the rewarding effects of pursuing innovation using the BSC in terms of accounting and market performance in the long run. The short term rewarding effect only exists in market performance but not accounting performance.

Table 6.1: Descriptive Statistics and Univariate Analysis

Panel A: Descriptive Statistics of Sample

Variables	Mean	Standardized Deviation	Q1	Median	Q3	Skewness	Kurtosis
BSC	0.552	0.373	0	1	1	-0.192	3.21
INV	0.561	0.846	0	0	0.954	0.522	4.364
FIRMCOM	-5.64e-10	1.131	-0.866	0.22	0.878	-0.467	2.55
EME	0.287	0.591	-0.108	0.337	0.691	0.287	3.371
TECH	0.686	0.464	0	1	1	-0.804	1.646
CUS	1.880	0.037	1.857	1.886	1.908	-0.924	4.21
FIN	0.305	0.236	0.098	0.252	0.483	0.79	2.890
MAR	0.433	0.392	0.167	0.361	0.629	0.185	4.240

Note: Refer to Appendix A for variable definitions and measurements.

Table 6.1 Panel B: Univariate Analysis

	Firms with the use of the BSC (N=978)					Firms without the use of the BSC (N=795)					T-Test	Z-test
Variables	**Mean**	**Standardized deviation**	**Q1**	**Median**	**Q3**	**Mean**	**Standardized deviation**	**Q1**	**Median**	**Q3**		
INV	0.613	0.879	0	0	1.041	0.304	0.592	0	0	0.301	-5.779*** (0.000)	-4.816*** (0.000)
FIRMCOM	0.173	1.087	-0.455	0.406	0.948	-0.863	0.935	-0.153	-0.965	-0.347	-15.239*** (0.000)	-16.2*** (0.000)
EME	0.312	0.601	-0.07	0.373	0.724	0.162	0.521	-0.158	0.144	0.517	-3.999*** (0.000)	-2.355*** (0.000)
TECH	0.781	0.413	1	1	1	0.210	0.408	0	0	0	-21.717*** (0.000)	-2.355*** (0.009)
CUS	1.880	0.037	1.857	1.886	1.908	1.880	0.336	1.863	1.886	1.903	-0.011 (.495)	-0.0004 (0.499)
FIN	0.301	0.232	0.101	0.252	0.463	0.326	0.256	0.091	0.240	0.548	1.643 (0.101)	0.388 (0.698)
MAR	0.442	0.404	0.165	0.365	0.651	0.393	0.328	0.171	0.334	0.514	-1.944** (0.026)	-0.7622 (0.223)

Notes: All variables are winsorized at 99%. **, *** Significant at 5% and 1% level (two tailed test), respectively, p values are in parentheses.

Refer to Appendix A for variable definitions and measurements.

Table 6.2: Correlation Matrix

Variables	BSC	FIRMCOM	EME	TECH	CUS	INV	ACCT	MAR	LOGS	LEV	LPPEE	REG	STRATEGY	ACCTV	MARV
BSC	1		0.095*** (0.000)	0.459*** (0.000)	0.001* (0.091)	0.136*** (0.000)	-0.039 (0.101)	0.046* (0.052)	0.152*** (0.000)	0.029 (0.000)	0.071*** (0.003)	0.014 (0.003)	0.186*** (0.000)	-0.055** (0.022)	-0.019 (0.437)
FIRMCOM	0.341*** (0.000)	1	0.799*** (0.000)	0.787*** (0.000)	-0.144*** (0.000)	0.187*** (0.000)	-0.349*** (0.000)	-0.078*** (0.001)	0.264*** (0.000)	0.049** (0.039)	0.513*** (0.000)	0.357*** (0.000)	0.582*** (0.000)	-0.07*** (0.000)	-0.112*** (0.000)
EME	0.095*** (0.000)	0.799*** (0.000)	1	0.274*** (0.000)	-0.049** (0.042)	0.057** (0.017)	-0.395*** (0.000)	-0.141*** (0.000)	0.163*** (0.000)	0.02 (0.403)	0.595*** (0.000)	0.454*** (0.000)	0.544*** (0.000)	-0.092*** (0.000)	-0.179*** (0.000)
TECH	0.459*** (0.000)	0.787*** (0.000)	0.274*** (0.000)	1	-0.001 (0.9613)	0.288*** (0.000)	-0.095*** (0.000)	0.071*** (0.003)	0.252** (0.000)	0.043* (0.071)	0.198*** (0.000)	0.057** (0.017)	0.358*** (0.000)	-0.038 (0.112)	-0.021 (0.388)
CUS	0.001* (0.091)	-0.144*** (0.000)	-0.049** (0.042)	-0.001 (0.9613)	1	0.233*** (0.000)	0.363*** (0.000)	0.289*** (0.000)	-0.023 (0.343)	-0.089*** (0.000)	-0.160*** (0.000)	-0.337*** (0.000)	-0.152*** (0.000)	-0.111*** (0.000)	-0.150*** (0.000)
INV	0.136*** (0.000)	0.187*** (0.000)	0.057** (0.017)	0.288*** (0.000)	0.233*** (0.000)	1	0.171*** (0.000)	0.241*** (0.000)	0.357*** (0.000)	-0.023 (0.336)	-0.103*** (0.000)	-0.312*** (0.000)	0.263*** (0.000)	0.024 (0.322)	0.035 (0.140)
ACCT	-0.039 (0.101)	-0.349*** (0.000)	-0.395*** (0.000)	-0.095*** (0.000)	0.363*** (0.000)	0.171*** (0.000)	1	0.512*** (0.000)	-0.065** (0.006)	-0.008 (0.746)	-0.459*** (0.000)	-0.505*** (0.000)	-0.439*** (0.000)	0.094*** (0.000)	0.083*** (0.000)
MAR	0.046* (0.052)	-0.078*** (0.001)	-0.141*** (0.000)	0.071*** (0.003)	0.289*** (0.000)	0.241*** (0.000)	0.512*** (0.000)	1	-0.076*** (0.001)	0.293*** (0.000)	-0.227*** (0.000)	-0.298*** (0.000)	-0.267*** (0.000)	0.049*** (0.000)	-0.095*** (0.000)
LOGS	0.152*** (0.000)	0.264*** (0.000)	0.163*** (0.000)	0.252** (0.000)	-0.023 (0.343)	0.357*** (0.000)	-0.065*** (0.006)	-0.076*** (0.001)	1	0.018 (0.446)	-0.037* (0.099)	-0.085*** (0.000)	0.74*** (0.000)	-0.147** (0.000)	-0.105*** (0.000)
LEV	0.029 (0.000)	0.049** (0.039)	0.02 (0.403)	0.043* (0.071)	-0.089*** (0.000)	-0.023 (0.336)	-0.008 (0.746)	0.293*** (0.000)	0.018 (0.446)	1	-0.02 (0.392)	0.02 (0.399)	-0.01 (0.671)	0.053** (0.025)	0.045* (0.06)
LPPEE	0.071*** (0.003)	0.513*** (0.000)	0.595*** (0.000)	0.198*** (0.000)	-0.160*** (0.000)	-0.103*** (0.000)	-0.459*** (0.000)	-0.227*** (0.000)	-0.037* (0.099)	-0.02 (0.392)	1	0.760*** (0.000)	0.513*** (0.000)	-0.087*** (0.000)	-0.287*** (0.000)
REG	0.014 (0.003)	0.357*** (0.000)	0.454*** (0.000)	0.057** (0.017)	-0.337*** (0.000)	-0.312*** (0.000)	-0.505*** (0.000)	-0.298*** (0.000)	-0.085*** (0.000)	0.02 (0.399)	0.760*** (0.000)	1	0.352*** (0.000)	-0.010 (0.686)	-0.176*** (0.000)
STRATEGY	0.186*** (0.000)	0.582*** (0.000)	0.544*** (0.000)	0.358*** (0.000)	-0.152*** (0.000)	0.263*** (0.000)	-0.439*** (0.000)	-0.267*** (0.000)	0.74*** (0.000)	-0.01 (0.671)	0.513*** (0.000)	0.352*** (0.000)	1	-0.157*** (0.000)	-0.169*** (0.000)
ACCTV	-0.055** (0.022)	-0.07*** (0.000)	-0.092*** (0.000)	-0.038 (0.112)	-0.111*** (0.000)	0.024 (0.322)	0.094*** (0.000)	0.049*** (0.000)	-0.147** (0.000)	0.053** (0.025)	-0.087*** (0.000)	-0.010 (0.686)	-0.157*** (0.000)	1	0.294*** (0.000)
MARV	-0.019 (0.437)	-0.112*** (0.000)	-0.179*** (0.000)	-0.021 (0.388)	-0.150*** (0.000)	0.035 (0.140)	0.083*** (0.000)	-0.095*** (0.000)	-0.105*** (0.000)	0.045* (0.06)	-0.287*** (0.000)	-0.176*** (0.000)	-0.169*** (0.000)	0.294*** (0.000)	1

Note: All variables are winsorized at 99%. **, *** Significant at 5% and 1% level (two tailed test), respectively, p values are in parentheses. Refer to Appendix A for variable definitions and measurements.

Table 6.3: Results of Innovation and the Use of the BSC

$$INV_{it} = \alpha_{10} + \beta_{11}BSC_{it} + \beta_{12}REG + \beta_{13}LOGS_{it} + \beta_{14}LEV_{it} + \beta_{15}STRATEGY_{it} + Industry\ Fixed\ Effects + Year\ Fixed\ Effects + e_{10}$$

Variable	Expected Sign	Innovation
BSC	+	0.135***
		(0.000)
REG	-	-0.437
		(0.26)
LOGS	+	0.362***
		(0.000)
LEV	-	-0.0002
		(0.525)
STRATEGY	+	0.056*
		(0.069)
Industry Fixed Effects		Yes
Year Fixed Effects		Yes
Company Variance		0.0899
Adjusted R^2		63.92%
Variance Inflation Indicator (VIF)		1.62

Note: All variables are winsorized at 99%. **, *** Significant at 5% and 1% level (two tailed test), respectively.

Refer to Appendix A for variable definitions and measurements.

Table 6.4 Panel A: Competence and the Use of the BSC

$FIRMCOM_{it} (EME_{it}, TECH_{it}, CUS_{it})$

$$= \alpha_{20} + \beta_{21}BSC_{it} + \beta_{22}LOGS_{it} + \beta_{23}LEV_{it} + \beta_{24}LPPEE_{it} + Industry\ Fixed\ Effects + Year\ Fixed\ Effects + e_{20}$$

Variables	Expected sign	Firm Overall Competences	Employee Competence	Technology Competence	Customer Competence
BSC	+	0.747*** (0.000)	0.10*** (0.001)	0.423*** (0.000)	0.004** (0.027)
LOGS	+	0.038 (0.606)	-0.053 (0.184)	0.097*** (0.004)	-0.002 (0.385)
LEV	-	0.0009 (0.102)	0.0001 (0.639)	0.0004* (0.083)	-0.0001 (0.399)
LPPEE	+	0.676*** (0.000)	0.621*** (0.000)	-0.055 (0.220)	-0.010*** (0.003)
Industry Fixed Effects		Yes	Yes	Yes	Yes
Year Fixed Effects		Yes	Yes	Yes	Yes
Company Variance		0.2356	0.0387	0.0562	0.0356
Adjusted R^2		37.55%	45.37%	32.99%	46%
VIF		1.02	1.02	1.02	1.02

Note: All variables are winsorized at 99%. *, **, *** Significant at 10%, 5% and 1% level (two tailed test), respectively.

Refer to Appendix A for variable definitions and measurements.

Table 6.4 Panel B: Mediating Effects of Competence

$$INV_{it} = \alpha_{60} + \beta_{61}BSC_{it} + \beta_{62}FIRMCOM_{it}(EME_{it}, TECH_{it}, CUS_{it}) + \beta_{63}LOGS_{it} + \beta_{64}LEV_{it} + \beta_{65}STRATEGY_{it} + Industry\ Fixed\ Effect$$
$$+ Year\ Fixed\ Effects + e_{60}$$

Variables	Expected Sign	Firm Overall Competences	Employee Competence	Technology Competence	Customer Competence
BSC	+	0.096*** (0.006)	0.129*** (0.000)	0.097*** (0.007)	0.139*** (0.007)
FIRMCOM	+	0.057*** (0.000)			
EME	+		0.077*** (0.002)		
TECH	+			0.09*** (0.004)	
CUS	+				0.723* (0.099)
LOGS	+	0.380*** (0.000)	0.387*** (0.000)	0.356*** (0.000)	0.358*** (0.000)
LEV	−	-0.0003 (0.423)	-0.0002 (0.498)	-0.0003 (0.448)	-0.0002 (0.539)
STRATEGY	+	0.042 (0.181)	0.043 (0.172)	0.054* (0.079)	0.068** (0.028)
Industry Fixed Effects		Yes	Yes	Yes	Yes
Year Fixed Effects		Yes	Yes	Yes	Yes
Company Variance		0.0904	0.0897	0.0899	0.0876
Adjusted R^2		63.53%	63.75%	63.66%	64.66%
VIF		1.97	1.71	1.66	1.54

Note: All variables are winsorized at 99%. *, **, *** Significant at 10%, 5% and 1% level (two tailed test), respectively.

Refer to Appendix A for variable definitions.

Table 6.5 Panel A: OLS Results of Accounting Performance Consequences

Current Accounting Performance

$$ACCT_{it} = \alpha_{ols10} + \beta_{ols11}INV_{it} + \beta_{ols12}LOGS_{it} + \beta_{ols13}LEV + \beta_{ols14}LPPEE_{it} +$$

$$\beta_{ols15}FINV_{it} + \beta_{ols16}FIN_{it-1} + e_{10}$$

Future Accounting Performance

$$ACCT_{it+5} \, (ACCT_{it+10}) = \alpha_{ols20} + \beta_{ols21}INV_{it} + \beta_{ols22}LOGS_{it} + \beta_{ols23}LEV +$$

$$\beta_{ols24}LPPEE_{it} + \beta_{ols25}FINV_{it} + e_{20}$$

Variables	Expected Sign	Current Performance (t)	Future Performance (t+5)	Future Performance (t+10)
INV	+	-0.004*	0.047***	0.057***
		(0.058)	(0.000)	(0.000)
LOGS	+	0.002	-0.057***	-0.067***
		(0.493)	(0.000)	(0.000)
LEV	–	0.0001	-0.005***	-0.006***
		(0.128)	(0.000)	(0.000)
LPPEE	+	-0.009***	-0.159***	-0.167***
		(0.000)	(0.000)	(0.000)
ACCTV	–	0.006***	0.024**	-0.011
		(0.002)	(0.025)	(0.473)
FIN_{t-1}	+	0.953***		
		(0.000)		
Adjusted R^2		93.76%	29.61%	32.90%
VIF		1.19	1.09	1.11
Number of Observations		1,600	1,101	627

Note: All variables are winsorized at 99%. *, **, *** Significant at 10%, 5% and 1% level (two tailed test), respectively.

Refer to Appendix A for variable definitions and measurements.

Table 6.5 Panel B: Accounting Performance-Stage 1 Regression

$$INV_{it} = \alpha_{s10} + \beta_{s11}BSC_{it} + \beta_{s12}EMSALES_{it} + \beta_{s13}REG_{it} + e_{s10}$$

Variables	Expected Sign	Innovation (t)	Innovation (t+5)	Innovation (t+10)
BSC	+	0.190*** (0.000)	0.245*** (0.000)	0.296*** (0.000)
EMSALES	+	-25.481*** (0.000)	-23.12*** (0.000)	-27.019*** (0.000)
REG	-	-0.857*** (0.000)	-0.876*** (0.000)	-0.927*** (0.000)
Adjusted R^2		27.19%	28.78%	34.37%
F-statistics		83.435*** (0.000)	76.50*** (0.000)	57.794*** (0.000)
Number of Observations		1,733	1,101	627

Note: All variables are winsorized at 99%. *, **, *** Significant at 10%, 5% and 1% level (two tailed test), respectively.

Refer to Appendix A for variable definitions and measurements.

Table 6.5 Panel C: Accounting Performance-Stage 2 Regression

Current Accounting Performance

$$ACCT_{it} = \alpha_{s20} + \beta_{s21}INV_{Residual_{it}} + \beta_{s22}LOGS_{it} + \beta_{s23}LEV + \beta_{s24}LPPEE_{it} +$$

$$\beta_{s25}ACCTV_{it} + \beta_{s26}ACCT_{it-1} + e_{80}$$

Future Accounting Performance

$$ACCT_{it+5} \ (ACCT_{it+10}) = \alpha_{s20} + \beta_{s21}INV_{Residual_{it}} + \beta_{s22}LOGS_{it} + \beta_{s23}LEV +$$

$$\beta_{s24}LPPEE_{it} + \beta_{s25}ACCTV_{it} + e_{80}$$

Variables	Expected sign	Current Accounting Performance (t)	Future Accounting Performance (t+5)	Future Accounting Performance (t+10)
INV-HAT	+	0.0002 (0.962)	0.177*** (0.000)	0.152*** (0.000)
LOGS	+	-0.0003 (0.994)	-0.133*** (0.000)	-0.129*** (0.000)
LEV	-	0.0001 (0.112)	-0.005*** (0.000)	-0.006*** (0.000)
LPPEE	+	-0.009*** (0.0000)	-0.138*** (0.000)	-0.145*** (0.000)
ACCTV	-	0.006*** (0.006)	0.008 (0.520)	-0.026 (0.13)
$ACCT_{t-1}$	+	0.951*** (0.000)		
Adjusted R^2		43.77%	11.12%	21.95%
VIF		1.13	1.03	1.03
Hausman-chi2		109.71*** (0.000)	61.73*** (0.000)	30*** (0.000)
Overidentification-Basmann Chi Square		0.854 (0.653)	3.712** (0.156)	1.309 (0.520)
Number of Observations		1,600	1,101	627

Note: All variables are winsorized at 99%. *, **, *** Significant at 10%, 5% and 1% level (two tailed test), respectively.

INV-HAT represents the residuals from the first stage regression. Refer to Appendix A for other variable definitions and measurements.

Table 6.6 Panel A: OLS Results of Market Performance Consequences

Current Market Performance

$$MAR_{it} = \alpha_{ols30} + \beta_{ols31}INV_{it} + \beta_{ols32}LOGS_{it} + \beta_{ols33}LEV + \beta_{ols34}LPPEE_{it} +$$

$$\beta_{ols35}MARV_{it} + e_{30}$$

Future Market Performance

$$MAR_{it+5}\ (MAR_{it+10}) = \alpha_{ols40} + \beta_{ols41}INV_{it} + \beta_{ols42}LOGS_{it} + \beta_{ols43}LEV +$$

$$\beta_{ols44}LPPEE_{it}\ + \beta_{ols45}MARV_{it} + e_{40}$$

Variables	Expected Sign	Current Performance (t)	Future Performance (t+5)	Future Performance (t+10)
INV	+	0.143*** (0.000)	0.147*** (0.000)	0.136*** (0.000)
LOGS	+	-0.17*** (0.000)	-0.154*** (0.000)	-0.146*** (0.000)
LEV	_	0.005*** (0.000)	-0.001 (0.487)	-0.004** (0.033)
LPPEE	+	-0.152*** (0.000)	-0.120*** (0.000)	-0.133*** (0.000)
MARV	_	-8.797*** (0.002)	-3.235** (0.008)	-0.3.52** (0.035)
Adjusted R^2		25.91%	14.87%	13.96%
VIF		1.11	1.10	1.10
Number of Observations		1,733	1,101	627

Note: All variables are winsorized at 99%. *, **, *** Significant at 10%, 5% and 1% level (two tailed test), respectively.

Refer to Appendix A for variable definitions and measurements.

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Table 6.6 Panel B: Market Performance-Stage 1 Regression

$$INV_{it} = \alpha_{s10} + \beta_{s11}BSC_{it} + \beta_{s12}EDUEXP_{it} + \beta_{s13}REG_{it} + e_{s10}$$

Variables	Expected Sign	Innovation (t)	Innovation (t+5)	Innovation (t+10)
BSC	+	0.087* (0.074)	0.129** (0.019)	0.142** (0.029)
EDUEXP	+	0.246*** (0.000)	0.305*** (0.000)	0.395*** (0.000)
REG	-	-0.889*** (0.000)	-0.899*** (0.000)	-0.968*** (0.000)
Adjusted R^2		26.89%	29.57%	36.08%
F-statistics		76.282*** (0.000)	82.49*** (0.000)	66.147*** (0.000)
Number of Observations		1,733	1,101	627

Note: All variables are winsorized at 99%. *, **, *** Significant at 10%, 5% and 1% level (two tailed test), respectively.

Refer to Appendix A and B for variable definitions and measurements.

Table 6.6 Panel C: Market Performance-Stage 2 Regression

Current Market Performance Model

$$MAR_{it} = \alpha_{s30} + \beta_{s31}INV_{Residual_{it}} + \beta_{s32}LOGS_{it} + \beta_{s33}LEV_{it} + \beta_{s34}LPPEE_{it} + \beta_{s35}MARV_{it} + e_{s30}$$

Future Market Performance Model

$$MAR_{it+5} \text{ or } MAR_{it+10} = \alpha_{s30} + \beta_{s31}INV_{Residual_{it}} + \beta_{s32}LOGS_{it} + \beta_{s33}LEV_{it} + \beta_{s34}LPPEE_{it} + \beta_{s35}MARV_{it} + e_{s30}$$

Variables	Expected sign	Current Market Performance (t)	Future Market Performance (t+5)	Future Market Performance (t+10)
INV-HAT	+	0.282*	0.249***	0.220***
		(0.000)	(0.000)	(0.000)
LOGS	+	-0.252***	-0.222***	-0.199***
		(0.000)	(0.000)	(0.000)
LEV	-	0.005***	-0.0005	-0.004**
		(0.000)	(0.726)	(0.000)
LPPEE	+	-0.139***	-0.104***	-0.115***
		(0.0000)	(0.000)	(0.000)
MARV	-	-9.433***	-3.895***	-3.960**
		(0.000)	(0.002)	(0.019)
Adjusted R^2		18.45%	11.08%	11.86%
VIF		1.11	1.05	1.03
Hausman-chi2		33.34***	12.24***	6.52**
		(0.000)	(0.000)	(0.01)
Overidentifitication-Basmann Chi Square		1.894 (0.388)	5.165 (0.176)	8.76** (0.013)
Number of Observations		1,733	1,101	627

Note: All variables are winsorized at 99%. *, **, *** Significant at 10%, 5% and 1% level (two tailed test), respectively**.**

INV-HAT represents the residuals from the first stage regression. Refer to Appendix A for other variable definitions and measurements.

Table 6.7: Summary of Hypotheses Testing

Hypothesis	Estimation method	Result
H1	Multilevel regression	Supported
H2a	Multilevel regression	Supported
H2b	Multilevel regression	Supported
H2c	Multilevel regression	Supported
H2d	Multilevel regression	Supported
H3a	Two stage least squares	Partially Supported
H3b	Two stage least squares	Supported

Chapter 7

Conclusions, Limitations and Future Research

Firms are in constant search for resources and competences in order to be innovative. It is promising that firms can achieve innovation through the appropriate use of strategic management control system. Therefore, this dissertation explores the connection between the use of the BSC and innovation. Based on the RBV, the KBV, the agency theory and the contingency theory, this study develops a theoretical framework which suggests the mediating effect of firm competences in linking the use of the BSC and innovation, as well as its performance consequences.

This investigation provides empirical evidence that the use of the BSC is positively associated with firms' innovation. Given that the BSC can provide the right focus and support needed for innovation, the results are consistent with prior literature (Daneels, 2002; Jarrar and Smith, 2011; Wu, 2012). The overall competences and the three competence perspectives have been considered in studying the mediating effects of firm competences, including employee, technology and customer, on the relation between the use of the BSC and innovation. The results confirm the mediating role of employee, technology and customer competence, as well as firm overall competences in the relationship between the use of the BSC and innovation. In addition, this study offers

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evidence on the performance consequences of pursuing innovation for firms that use the BSC. The results indicate a rewarding effect of being innovative because innovation for firms that use the BSC is positively associated with firms' market performance contemporaneously and prospectively. As for accounting performance, innovation for firm that use the BSC is positively associated with future accounting performance but not with current accounting performance. It reveals the significance of considering the time frame in investigating the innovation-performance relationship. Prior literature presents mixed findings in testing the relationship between firm innovation and accounting performance. Therefore, it is not uncommon to find the insignificant results between innovation and current accounting performance in this study.

This dissertation provides implications for both researchers and practitioners. For researchers, this study develops a framework for the theoretical connection between the use of the BSC and innovation, and promotes the mediating role of firm competences in the relation. It contributes to the understanding of innovation by incorporating multidisciplinary concepts from the perspective of strategic management accounting (the use of the BSC) and operation management (firm competences). This dissertation is an example which illustrates the research opportunities offered by the multidisciplinary studies. Additionally, this study introduces potentially new composite measures to proxy for innovation strategy and firm overall competences using publicly available data.

For managers, this study offers practical insights on the determinants of innovation from the perspective of firm competences. It advocates the development of firm competences such as superior employee skills, advanced technology and extensive customer knowledge in pursuing innovation. It enables managers to focus on priorities

which are directly related to their objectives (such as innovation) when allocating limited resources. The empirical evidence provides reference for managers to follow with the expectation of achieving better innovation.

Moreover, the study provides guidance as to using the strategic management control system to better organize and utilize firm resources. This dissertation confirms and emphasizes the importance of the integration between strategy and operations. The supported positive innovation-performance relationship highlights the rewarding effects of being innovative. It motivates firms to be more forward-thinking as to engage in innovation for long term benefits and competitive advantage.

The dissertation is by no means without some limitations. First, this study only uses data based on public U.S. companies. Future research can expand the data search to a wide range which including different countries in order to achieve greater generalizations. Second, several measures used in this study are less refined. The classification of whether firms use the BSC has the potential to be improved even though it is a standardized method in prior literature. Future research can potentially develop a direct measure (possibly using survey method) to identify firms using the BSC and provide more consistency between the proxy and objective measures. This study uses the natural logarithm of PPE to measure the investment in working facilities to proxy for innovation strategy. It might be misleading considering the increasing trend of investing in intangible assets. This measure ignores the fact that firms can achieve innovation by investing heavily in intangible assets rather than tangible assets. This will require future researchers to consider a more specific measure to capture firms' investment in innovation related assets. Third, this study is limited to publicly available data. Future

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research can combine different methods in order to capture a more complete information portfolio to investigate the relationship between strategic management and innovation.

Moreover, future research can examine whether the relationship between the use of the BSC and innovation vary based on the different weights assigned to nonfinancial performance measures in evaluating performance. Future research has the potential to capture the effects of different management control systems such as JIT, Kaizen and TQM on innovation.

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Appendix A

Definitions and Measurements of Variables

Concepts	Variable	Definition	Measurements	Supporting literature	Data Source
The use of the BSC	BSC	Whether the firm uses the BSC	Binary variable takes the value of 1 if the firm uses the BSC, 0 otherwise	Said et al., 2003	Manually collected from SEC
Innovation	INV	Significant improvements or developments of process, products, services or programs	Natural logarithm of granted patents number	Ahuja, 2000; Srivastava & Gnyawali, 2011; Malinoski and Perry, 2015	USPTO
Firm overall competence	FIRMCOM	Firms' overall ability in achieving predetermined goals.	A composite measure includes employee, technology and customer competence	Barney,1991; Danneels, 2002; Grant, 1996	Compustat, ASUG and ACSI
Employee competence	EME	The ability of employee required for the successful accomplishment of tasks	Natural logarithm of retirement cost divided by the number of employee	Lall, 1980; Canto & Gonzalez, 1999; Bryant et al. , 2004	Compustat
Technology competence	TECH	Firms' ability to apply technically related resources	Binary variable coded as 1 if the firm uses	Ritter & Gemunden, 2004;	Compustat and ASUG

		(manufacturing facilities and know-how, and IT system such as SAP, ERP) in producing high-quality products/services or facilitating the management-controlled activities	SAP, ERP, big data processing, or other high technology systems or devices; 0 otherwise	Fornell et al., 1996 Danneels, 2002	
Customer competence	CUS	Firms' ability to identify, understand and satisfy the customer needs.	Natural logarithm of customer satisfaction score	Bryant et al., 2004; Fornell et al., 1996	ACSI
Accounting performance	ACCT	Firms' ability to generate revenue from the available resources	Return on assets (ROA) calculated as gross profit divided by total assets	Chen & Wong, 2004; Hall & Bagchi-Sen, 2002	Compustat
Market performance	MAR	Firms' ability to generate return from stock market	Market-adjusted return calculated by subtracting the value-weighted market return from firms' stock return	Bushee and Noe, 2000; Lang and Lundholm, 1993	CRSP

Appendix B

Control Variables

	Variables	Measurements	Supporting literature	Source
Innovation Controls	Size (LOGS)	Natural logarithm of annual sales	O'Brien, 2003	Compustat
	Leverage (LEV)	Natural logarithm of total debt over equity	Fama and French, 1992	Compustat
	Innovation Strategy (STRATEGY)	A composite measure which includes (1) the market-to-book ratio, (2) a natural logarithm of net plant, property, and equipment, (3) the ratio of employee to sales, (4) natural logarithm of firm assets, and (5) CEO's innovation related education and experience (a dummy variable which takes the value of 1 if the CEO has innovation related education such as degree in technology, science and engineering, or	Hambrick and Mason, 1984; Hirshleifer et al., 2012; Said et al, 2003; Thomas et al, 1991	Compustat CRSP

		experience such as worked for technology company before; 0 otherwise).		
Innovation instruments	Industry regulation (REG)	Dummy variable which takes the value of 1 if the firm is in the regulated industry (SIC codes 40-49); 0 otherwise	Said et al., 2003	Compustat
	Firms' ability in providing products and services efficiently (EMSALES)	The number of employees divided by annual sales	Ittner et al., 1997; Said et al., 2003 Thomas et a, 1991	Compustat
	CEO's innovation related background (EDUEXP)	Dummy variable which takes the value of 1 if the CEO has innovation related education such as degree in technology, science and engineering, or experience such as worked for technology company before; 0 otherwise	Hambrick and Mason, 1984	Compustat
Firm competences controls	Size (LOGS)	Natural logarithm of annual sales	O'Brien, 2003	Compustat
	Leverage (LEV)	Natural logarithm of total debt divided by equity	Fama and French, 1992	Compustat
	Investment in tangible assets (LPPEE)	Natural logarithm of net property, plant, and equipment divided by number of employees	Danneels, 2002	Compustat

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Performance controls	Size (LOGS)	Natural logarithm of annual sales	O' Brien, 2003	Compustat
	Leverage (LEV)	Natural logarithm of total debt divided by equity	Fama and French, 1992	Compustat
	Investment in tangible assets (LPPE)	Natural logarithm of net property, plant, and equipment divided by number of employees	Danneels, 2002	Compustat
	Accounting performance volatility (ACCTV)	Standard deviation of annual return on assets over the previous 2 years	Jeter and Chaney, 1992; Warfield et al., 1995	Compustat
	Market performance volatility (MARV)	Standard deviation of annualized daily stock return over the previous 2 years	Jeter and Chaney, 1992; Warfield et al., 1995	CRSP
	Lagged accounting performance ($ACCT_{t-1}$)	Lagged ROA calculated as the gross profit in year t-1 divided by total asset in year t-1;	Said et al., 2003	Compustat
	Lagged market performance (MAR_{t-1})	Lagged market-adjusted return calculated by subtracting the value-weighted market return from firms' stock return in year t-1	Bushee and Noe, 2000; Lang and Lundholm, 1993; Said, et al., 2003	CRSP