Summer 2012

Impact of Business Intelligence and IT Infrastructure Flexibility on Competitive Advantage: An Organizational Agility Perspective

Xiaofeng Chen
University of Nebraska-Lincoln

IMPACT OF BUSINESS INTELLIGENCE AND IT INFRASTRUCTURE FLEXIBILITY ON COMPETITIVE ADVANTAGE: AN ORGANIZATIONAL AGILITY PERSPECTIVE

BY

Xiaofeng Chen

A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of Business

(Management)

Under the Supervision of Professor Keng L. Siau

Lincoln, Nebraska

August, 2012

IMPACT OF BUSINESS INTELLIGENCE AND IT INFRASTRUCTURE FLEXIBILITY ON COMPETITIVE ADVANTAGE: AN ORGANIZATIONAL AGILITY PERSPECTIVE

Xiaofeng Chen, Ph.D.

University of Nebraska, 2012

Advisor: Keng L. Siau

There is growing use of business intelligence (BI) for better management decisions in industry. However, empirical studies on BI are still scarce in academic research. This research investigates BI from an organizational agility perspective. Organizational agility is the ability to sense and respond to market opportunities and threats with speed, and BI can help in the sensing role of organizational agility. Drawing on the systems theory, dynamic capabilities framework, and literature on competitive advantage, organizational agility, business intelligence, and IT infrastructure flexibility, we hypothesize that BI use and IT infrastructure flexibility are major sources of organizational agility. We developed a research model to examine the effects of BI and IT infrastructure flexibility on organizational agility. This model also examines how organizational agility mediates the effects of BI and IT infrastructure flexibility on an organization's competitive advantage. Survey data were collected and used to assess the model. The results support the hypothesis that BI and IT infrastructure flexibility are significant sources of organizational agility, and organizational agility partially mediates the effects of BI and IT infrastructure flexibility on an organization's competitive advantage. This research is a pioneer work that empirically investigates the significance of BI in the business context. It also demonstrates from the organizational agility perspective that information technology and

systems have strategic values for organizations, as they are significant sources of organizational agilities and competitive advantages.

ACKNOWLEDGEMENTS

I would like to sincerely thank my dissertation advisor, Dr. Keng L. Siau, for his guidance, mentorship, encouragement, and tremendous support during my preparation of this dissertation and throughout the entire doctoral program at the University of Nebraska-Lincoln. He is a great mentor and kind friend. I am grateful to have had the opportunity to work with and learn from him.

I also would like to thank the members of the supervisory committee, Dr. Fiona Hui Nah, Dr. Sid Davis, and Dr. Peter Revesz for their time and guidance in various stages of the dissertation. It has been my honor and privilege to have them on my dissertation committee.

Finally, and most importantly, I want to express my love and appreciation to my wife, Qing Tian and my lovely kids, Charles and Caroline. Without their unconditional love, support, encouragement and sacrifice, my graduate work and this dissertation would not have been possible. Special thanks also go to my parents, Huimin Zhang and Liangwen Chen, who raised me and taught me to be a good person and encouraged me to work hard to realize dreams.

TABLE OF CONTENTS

Chapter 1

Introduction

1.1 Overview

There is growing use of business intelligence (BI) for better management decisions in industry. Since late 2000s, BI has become a revived hot topic in industry and practice: BI was at the top of the priority agendas in organizations (Gartner 2008; Gartner 2009; LaValle et al. 2011); BI skills are highly pursued (Brandel 2009); BI is the top application and technology under development in 2009 (Luftman and Ben-Zvi 2010). However, empirical studies on BI are still scarce in academic research. Existing BI studies show inconsistent results of BI's contribution to organizational performance (Watson et al. 2002; Gessner and Volonino 2005; Watson et al. 2006). The significance of BI is uncertain both in industry and in academic. This research investigates the fundamental question of whether or not BI has a significant impact on organizational performance from an organizational agility perspective. Organizational agility is the ability to sense and respond to market opportunities and threats with speed, and BI can help in the sensing role of organizational agility. Drawing on the systems theory, dynamic capabilities framework, and literature on competitive advantage, organizational agility, business intelligence, and IT infrastructure flexibility, we hypothesize that BI use and IT infrastructure flexibility are major sources of organizational agility. We developed a research model to examine the effects of BI and IT infrastructure flexibility on organizational agility. This model also examines how organizational agility mediates the effects of BI use and IT infrastructure flexibility on an organization's competitive advantage. Through the mediation role of organizational agility, we connect BI and IT infrastructure flexibility with competitive advantage and illustrate the strategic values of BI and IT infrastructure flexibility.

1.1.1 Research Question

The use of business intelligence (BI) to make better management decisions is becoming more prevalent in organizations of different industries. BI is an umbrella term that "describes the technologies, applications, and processes for gathering, storing, accessing, and analyzing data to help users make better decisions" (Wixom and Watson 2010, p. 14). Studies have shown that companies that invested in BI and coupled it with scrupulous practices have seen increased revenue and enormous cost savings (Watson et al. 2006). Nevertheless, some other companies that invested in BI did not reap the promised benefits (Watson et al. 2002; Gessner and Volonino 2005; Lonnqvist and Pirttimaki 2006). Jourdan et al. (2008) reviewed the BI literature up to 2006 and indicated that although there had been much published BI research, much of the research was still in the early stage (i.e., exploratory state). Although a BI-based organization has been proposed (Watson 2009; Wixom and Watson 2010), there is a lack of empirical studies on why organizations need to be BI-based and how other internal resources interact with BI to deliver a superior return on investment. BI has become a new information systems (IS) fashion since the late 2000s. However, there is a large discrepancy between the industry popularity of BI and the extent of academic research on BI. Although BI has been a hot topic in practice, there is a paucity of empirical BI academic research on why BI is important. The lack of empirical research on why BI is important makes the rationale to invest in BI weak, especially when researches show inconsistent returns on investment in BI. This research answers the question of why BI is critical in business and how BI interacts with other business resources to create strategic values.

1.1.2 The Theoretical Lens

To study the significance of BI in academic research, we need a theoretical lens to build theories that connect BI with business values and empirically test them. After reviewing the IS and strategic management literature, we found the organizational agility perspective a promising lens to study the questions mentioned earlier because it provides an elegant connection between BI and competitive advantage, which is critical to create strategic values for an organization.) Agility is an organizational trait (Christopher and Towill 2002). Organizational agility is an organization's ability to sense and respond to market opportunities and threats in a timely manner (Sambamurthy et al. 2003; Overby et al. 2006; and Watson and Wixom 2007). Organizational agility has been extensively studied in the IS discipline (El Sawy and Pavlou 2008; Fink and Neumann 2007; Gallagher and Worrell 2007; Hobbs 2010; Lee and Xia 2010; Lyytinen and Rose 2006; Sambamurthy et al. 2003; Seo et al. 2010; Tallon and Pinsonneault 2011; Tiwana and Konsynski 2010; Zaheer and Zaheer 1997). There is an established positive link between organizational agility and firm performance in the IS literature (Benaroch 2002; Sambamurthy et al. 2003; Fichman 2004; Benaroch et al. 2006).

In the strategic management literature, there is a long stream of research on sources of competitive advantages. The resource-based view (RBV) of the firm was developed to emphasize firm-level specific capabilities and assets (resources) that undergird a firm's competitive advantages (Penrose 1959; Wernerfelt 1984; Barney 1991; Mahoney and Pandian 1992). These resources need to be valuable, rare, inimitable, and nonsubstitutable (VRIN), to qualify as sources of a firm's competitive advantages. RBV has been criticized for its static nature. The dynamic capability framework was introduced to explain how competitive advantages are gained and held for the long term (Teece et al. 1997; Eisenhardt and Martin 2000; Teece 2007).

This study argues that organizational agility is a dynamic capability. The dynamic capability framework provides the theoretical foundation to explain why organizational agility is a source of an organization's competitive advantage. The next two sections further argue that organizational agility is a perfect lens to view the significance of BI and IT infrastructure flexibility.

1.1.3 Significance of BI through the Theoretical Lens

The systems theory states that systems are composite things and possess properties (Von Bertalanffy 1968; Ackoff 1971; Checkland 1981), which can be either individual system properties or emergent properties of interacting relationships between system components (Nevo and Wade 2010). Organizations are complex social systems. Organizational agility is one of the emergent properties. The sources of emergent properties are the components and their relationships (Holland 1998; Jackson 2000). There are two source components that can help improve organizational agility: (1) the component that can help sense and detect market opportunities and threats in a timely manner and (2) the component that can help act on or respond to market opportunities and threats in a timely manner. Based on existing literature, business intelligence (BI) can help sense market opportunities and threats (Elbashir et al. 2011; Mithas et al. 2011; Trkman et al. 2010; Wixom and Watson 2010), and flexible IT infrastructure can help respond to market opportunities and threats by facilitating the integration and reconfiguration of existing resources to develop new capabilities (Bharadwaj 2000; Bhatt and Grover 2005; Byrd and Turner 2000; Tiwana and Konsynski 2010). Therefore, business intelligence and IT infrastructure flexibility are enabling source components that can help improve organizational agility.

Because BI can raise awareness on the trends of products and customer changes, it can therefore contribute to organizational agility by providing timely information to detect changing trends. Literature has shown a positive link between organizational agility and competitive advantage. Because of the ability to contribute to organizational agility, BI becomes a strategic component for an organization's competitive advantage.

1.1.4 IT Infrastructure Flexibility through the Theoretical Lens

The other component contributing to organizational agility is IT infrastructure flexibility. Organizational agility allows an organization to integrate and reconfigure internal and external resources to act on opportunities or respond to threats. Nowadays, most organizations are IT enabled, especially in industries with rapid product and customer changes. Prior studies (e.g., Akkermans et al. 2003; Sambamurthy et al. 2003; Tiwana and Konsynski 2010; Lin 2010; Bush et al. 2010) have shown that IT infrastructure flexibility is a key factor for organizational agility and performance. A flexible IT infrastructure is a key enabler for timely integration and reconfiguration. Therefore, IT infrastructure flexibility can be a direct contributor to organizational agility.

BI is an IT-enabled system that is built on top of an organization's IT infrastructure. A flexible IT infrastructure will improve BI performance by providing more accurate and timely data and information with easily integrated data sources. Therefore, this study also investigated the relationship between IT infrastructure flexibility and BI practice.

In summary, this study uses organizational agility as a theoretical lens to view the strategic importance of BI and IT infrastructure. BI and IT infrastructure flexibility are significant sources of organizational agility because they contribute to the sensing/detecting and acting/responding dimensions of organizational agility, respectively.

1.2 Purpose of the Study

As mentioned in the forefront of the Introduction, BI is a new IS fashion in industries. Idea entrepreneurs (e.g., consultants, gurus, journalists, and vendors) have made substantial efforts to promote its use. Organizations spend millions, if not billions, of dollars and sometimes make organizational structure changes to implement BI. While BI is popular in industries and practices, BI academic research is still in its early stage. Existing BI studies focus on definition, case studies of BI best practices in leading companies (Wixom and Watson 2010), critical success factors (Yeoh and Koronios 2010), and maturity models (Lahrmann et al. 2011). However, IS research lacks empirical BI studies on the significance of BI. The fundamental question of whether or not BI has important or critical business values is left unanswered in academic literature. This question is especially pertinent because prior research shows inconsistent results of BI impacts on business performances.

This research aims to theoretically evaluate the significance of BI and empirically tested its importance in creating business values. It aims to build a theoretical model that is based on IS theories and strategic management fields to examine the relationships between business intelligence, IT infrastructure flexibility, organizational agility, and competitive advantage.

1.3 Research Methodology

Extant academic research on BI focuses on defining BI, determining the best BI practices, and measuring the maturity of BI implementation in organizations. This research empirically investigates the importance of BI.

A cross-sectional survey was used to test the research model. The study developed a survey instrument for collecting data. This survey instrument includes a new measurement scale for measuring business intelligence use. The other measurement scales for measuring other constructs in the model are adapted from existing scales that have been published and have passed reliability and validity tests.

The survey participants are business leaders (senior business managers) from U.S. companies that have at least 20 million dollars in annual revenue. The structural equation modeling technique is used to analyze the data and test the relationships between business intelligence use, IT infrastructure flexibility, organizational agility, and competitive advantage.

1.4 Organization of the Dissertation

The dissertation consists of eight chapters: (1) Introduction, (2) Research Background, (3) Theoretical Foundation, (4) Development of Research Model and Hypotheses, (5) Research Method, (6) Findings and Discussions, (7) Limitations and Future Research, Implications for Research and Practice, and (8) Conclusion.

The remainder of the dissertation is organized as follows: Chapter 2 reviews the current literature and identifies the knowledge gap in business intelligence, IT infrastructure flexibility, organizational agility, and competitive advantage. Chapter 3 describes the theoretical foundations of the hypotheses of this study. Chapter 4 presents the research model and hypotheses. Chapter 5 describes the research methodology of this study. Chapter 6 discusses the findings from the data. Chapter 7 discusses the limitations of the study, future research, and potential contributions of this research to the literature and practice. Chapter 8 summarizes the findings and contributions of the study.

Chapter 2

Research Background

As mentioned in Chapter 1, organizational agility is the theoretical lens we will use to investigate why BI is essential. Organizational agility is a term that is often used in the IS literature but has a close relationship with another term, dynamic capability, that is often used in the strategic management literature. When we search for what organizational agility can impact, we found that it is unavoidable to examine the three most studied constructs in the strategic management research. Those constructs are competitive action, competitive advantage, and competitive performance. There is a long stream of research on these constructs within the competitive dynamics research domain that is an essential part of the strategic management discipline. This study first presents as the research background the summaries of literature on these constructs in the competitive dynamics research. The literature of competitive dynamics research is relevant to this study because the key dependent variable, competitive advantage, of this study is in the competitive dynamic domain. It is unavoidable to encounter other key constructs in competitive dynamics domain when we research the construct of competitive advantage. It is necessary to explain why we chose as our dependent variable competitive advantage and not other constructs in the competitive dynamics research. The clarification can make the research model more theoretically sound.

Then, the remainder of Chapter 2 summarizes the literature that is pertinent to the predictive variables of the research model.

2.1 Competitive Dynamics Research: the Dependent Variable

This section discusses why this study chose competitive advantage, not other relevant constructs from the competitive dynamics research, as the dependent variable for the research model.

2.1.1 Competitive Action and the Related Issues

Competitive action, competitive advantage, and competitive performance have been studied extensively in the strategic management discipline (Porter 1985; Barney 1991; Smith et al. 1991; D'Aveni 1994; Young et al. 1996; Teece et al. 1997; Ferrier et al. 1999; Grahovac and Miller 2009) and have started to draw attentions of IS researchers who have focused on IT business values in recent years (Sambamurthy et al. 2003; Chi and Ravichandran 2010; Gnyawali et al. 2010; Vannoy and Salam 2010; etc.). However, our review of the literature shows that there are issues with the studies of competitive action because of the lack of a systematic classification. The lack of a systematic classification leads to measurement issues of the construct in relevant studies, especially when studies involve two of the most studied characteristics of competitive action repertoire: action volume and action complexity.

This section discusses the concerns related to competitive action classification and the corresponding measurement issues. The discussion of the issues makes it clear that the construct of competitive action is a multidimensional construct. Competitive actions in different categories may have different effects on competitive performances when competitive actions are studied as an independent variable. Other factors in a business environment may also have heterogeneous impacts on different competitive actions in different categories when competitive actions are studied as a dependent variable. Thus, no matter whether competitive action is studied as a predictor or a dependent variable, further work is needed on its definition and classification. Without a theoretically sound classification of competitive actions, the validity of prior conclusions related to the characteristics of competitive action repertoire in research remains to be regarded with skepticism.

2.1.1.1 Extant Definitions of Competitive Action

Competitive action has been studied as an independent variable of organizational performances (Gnyawali et al. 2010; Vannoy and Salam 2010) and a dependent variable (Chi and Ravichandran 2010) in the IS literature. There are several definitions of competitive action in the literature, and these definitions are from different research streams. In general, competitive action is broadly defined as “a specific and detectable competitive move, such as a price cut or new product introduction, initiated by a firm to defend or improve its relative competitive position” (Smith et al. 1991, p. 61). From a market perspective, competitive action is defined as market-based moves that could change the status quo of the market or industry through innovations in products, services, and channels (Ferrier et al. 1999; Jacobson 1992). Examples of competitive actions include cutting price to increase market share, launching a new product or service, introducing a new sales channel to fracture the existing bases of market segment, or building a flexible infrastructure to increase the creation rate of new products or services (Ferrier et al. 1999; Sambamurthy et al. 2003). All these definitions from the strategic management field define competitive actions as market-oriented actions. However, in the IS field, the definition of competitive action has evolved into a broader concept that includes internally oriented actions. For example, Li et al. (2010) did not define the concept but classified competitive actions in their study into two groups: innovation vs. resource-based competitive actions. Chi and Ravichandran (2010) classified competitive actions in their study into two groups: internally versus externally oriented competitive actions. The actions included in their studies are not just market-oriented.

It is clear that competitive action is a term that describes a wide range of actions in the IS research. Different competitive actions will have different impacts on different competitive advantages and firm performances. Most example actions cited in the research are market-oriented. All these definitions assume or imply that competitive actions will improve competitive advantage (competitive position) for an organization. In studies that research the impact of competitive action, two characteristics of competitive action repertoire, action volume and action complexity, are often used empirically to test the impacts of competitive action. Action volume is defined as the total number of competitive actions initiated by an organization in a given time period (Chen and Hambrick 1995; Ferrier 2001; Chi and Ravichandran 2010). Action complexity refers to the extent to which a series of different types of competitive actions carried out by a firm in a given period (Ferrier 2001; Chi and Ravichandran 2010).

2.1.1.2 Classification of Competitive Action

Ferrier et al. (1999) proposed in the strategic management research context a competitive action classification that includes two categories of competitive actions: (1) strategic-related and (2) tactic-related competitive actions. Young et al. (1996) and Ferrier et al. (1999) proposed six main types of competitive actions that are market- or external-oriented: major new pricing actions, new marketing and promotional actions, new products, new capacity additions, new legal actions, and new signaling actions. In the IS field, the meaning of competitive action has been expanded. It include not only external-oriented, but also internal-oriented actions. To examine the impacts of different types of competitive actions in the IS research context, Li et al. (2010) classified competitive actions into two categories: (1) innovation related, which includes new products, pricing, and marketing actions; and (2) resource related, which includes operations and service, mergers, acquisitions, and other capacity/scale-related actions.

Although classifications of competitive actions have existed for many years, researchers have not used the classifications in their studies extensively. When studying the impact of competitive actions, researchers either used specific actions or a combination of various categories of competitive actions to measure the impact. Even those studies that classified competitive actions did not differentiate actions from different categories. When you combine actions from different categories and you count every action toward action volume and complexity, the reported impacts of the action volume and action complexity may become erroneous because you are assuming that all kinds of competitive actions will have the same effects, which is not true. Table 1 lists some examples of researches that show the issues related to competitive action. A theoretically sound classification of competitive action is needed, and research should study the impact of well-classified actions, rather than combined actions, on other dependent variables.

Table 1: Sample Research on Competitive Action

	Definition	Category	Statistical Role	Action volume and action complexity
Ferrier et al. 1999	Newly created, market oriented action	Six categories of market-oriented actions	Independent variable	Action volume positively affects the performance, but action complexity results are mixed
Ferrier 2001	Ordered, uninterrupted sequence of repeatable action events	Six categories of market-oriented actins	Independent and dependent variable	Action volume positively affects the performance, but action complexity results are mixed
Chi and Ravichandran 2010	Any externally oriented, market oriented	Internal vs. external oriented. Six categories of market-oriented actions	Dependent variable	Antecedents to action volume and complexity
Li et al. 2010	No definition	Innovation vs. resource related	Independent variable	Innovation related actions impacted firm performance (survival rate)
Gnyawali et al. 2010	No definition	Co-development and relational capability	Independent variable	Action volume (mixed results), Action Complexity (supports positive impact)

2.1.1.3 Issues of Competitive Action in Research

Although the definition of competitive action is consistently used in the strategic management literature, there is no single definition that is dominant and consistently used in IS literature. The strategic management literature defines competitive action as market-oriented actions, but IS literature expands the definition to include externally oriented or market-oriented and internally oriented or resource-oriented actions. Different research uses different definitions and classifications that are suited for their research domains in the IS research. As a result, action volume and action complexity, characteristics of action repertoire, often include actions from different categories, which results in the empirical results of the two characteristics being not consistent in the IS research.

Furthermore, competitive actions are largely industry specific. Different kinds of competitive actions have different purposes and will have different effects on firm performance in different industries. The empirical results of competitive actions are difficult to interpret and comprehend if the kinds of competitive action and performance are not available. This poses a generalization issue. For example, studies have shown that organizations need to undertake a complex repertoire of (competitive) actions to improve their performance (Ferrier et al. 1999; Gnyawali et al. 2010). However, Gnyawali et al. (2010) also acknowledged that in the context of the nascent industry on which their study was based, the competitive actions were unique to this industry and were mainly product/service innovations related. Because the competitive actions were unique to a particular industry, it will be difficult to compare the empirical results with the results from researches that study other industries.

As such, competitive action cannot be a reliable indicator of firm performance if the actions are not carefully selected and included in a study, nor can it be a consistent dependent variable without careful selection of what needs to be included in the measurement. We will further discuss the issues of competitive action later in this section when we examine the relationship between competitive action and competitive advantage.

2.1.2 Competitive Advantage and Competitive Performance

Competitive advantage and competitive performance are the other two prominent and often studied constructs in competitive dynamics research.

2.1.2.1 Definitions

Based on the research by Ferrier (2001) and Porter (1980), Rai and Tang (2010) defined competitive performance as "attainment of an organization's objectives in relation to its external environment." Some sample measurements of competitive performance include an organization's market share, profitability, growth, innovativeness, and cost leadership (Rai and Tang 2010).

Competitive advantage was traditionally defined as superior economic performance in strategic management research (Porter 1980; Ghemawat 1991; Teece et al. 1997) and was often used interchangeably with competitive performance (Porter 1985; Nidumolu and Knotts 1998, for example). More recent studies have redefined competitive advantage as an organization's ability to create more economic value than its competitors (Barney 1991; Peteraf and Barney 2003). For example, Peteraf and Barney (2003, p. 313) stated, "The extent of a firm's competitive advantage, in our terms, is an indicator of the firm's potential to best its rivals in terms of rents, profitability, market share, and other outcomes of interest." Meanwhile, Hofer and Schendel (1978, p. 25) defined competitive advantage as an organization's capability to create values for its buyers or "the unique position an organization develops vis-à-vis its competitors through its patterns of resource deployments." Therefore, competitive advantage is different from competitive performance. Competitive performance is the attainment or outcomes resulted from competitive advantage. Some sample measurements of competitive advantage include an organization's ability to produce current products at low cost, to charge competitive prices, and to respond to new customer needs quickly. Competitive advantage has also been described in terms of the attributes and resources of an organization that allow it to outperform others in the same industry or product market (Chaharbaghi and Lynch 1999). The first two definitions are about what competitive advantage is, whereas Chaharbaghi and Lynch's (1999) research is more concerned with how competitive advantage is created. What competitive advantage is and what helps build competitive advantage are the concerns of this study. As IS researchers, we are interested in investigating how IT/IS help to create an organization's strategic values.

2.1.2.2 Factors that Affect Competitive Advantage

Strategic management researchers have presented different models to identify the sources of an organization's competitive advantage. In general, these models can be classified into two domains (Teece et al. 1997): environmental-related models, such as Porter's competitive forces model (Porter 1980), and firm-specific resource–related models, such as the resource-based view (RBV) of the firm and dynamic capability framework (DCF).

The seminal work on competitive advantage on the industrial level by Porter (1980, 1985) reveals that an organization's performance and advantage are affected by five industry-level forces: entry barriers, threat of substitution, bargaining power of buyers, bargaining power of suppliers, and rivalry among industry incumbents. Porter (1980, 1985) prescribed two strategies to compete in a specific industry: cost leadership and quality differentiation.

RBV was developed and evolved by Penrose (1959), Wernerfelt (1984), and Barney (1991). RBV argues that organizations possess resources. Competitive advantages can be created by those resources that are valuable, rare, inimitable, and nonsubstitutable (VRIN) (Penrose 1959; Wernerfelt 1984; Barney 1991). The resource-based model provides a generic view of where competitive advantages can come, namely, the VRIN resources, but does not provide insights on how to develop those resources. RBV describes the characteristics of the resources that have strategic values but does not specify what those resources are. Another drawback of the resource-based model is its static nature (Teece et al. 1997; Eisenhardt and Martin 2000). It does not show the dynamics among the resources for sustained competitive advantages (Eisenhardt and Martin 2000). DCF argues that VRIN resources are keys to current competitive advantages but not enough for sustained (long-term) competitive advantages. DCF asserts that sustained competitive advantages rely on an organization's distinctive processes that create, deploy, and protect the intangible assets and are shaped by the firm's asset positions and the evolution path(s) it has adopted or inherited (Teece et al. 1997; Teece 2007). We believe that the two theories complement one another and DCF extends RBV by complementing the other aspects that help create competitive advantage, which are not specified in the RBV.

2.1.2.3 Dependent Variable for This Study: Competitive Advantage

In summary, competitive advantage is a capacity or a unique position that an organization develops to outperform its competitors. Competitive advantage grows out of a value-creating strategy. The two domains of the competitive dynamics research models explain where competitive advantage comes. One model domain examines competitive advantage from the industrial level, which is represented by Porter's five forces model (Porter 1980; 1985). The five forces model indicates that an organization can gain advantage over its competitors if it has more power over its customers, partners, and/or new competitors and it can weaken the intensity of competitive rivalry and/or the threat of substitute products/services. The other model domain investigates competitive advantage from the organizational level, which is represented by the RBV and DCF. These two models together provide a complete picture of how competitive advantage is gained and held. They show that an organization can have competitive advantages if it has VRIN resources and can hold competitive advantages if it has dynamic capability to build VRIN resources. DCF is the theoretical foundation that explains why organizational agility is a source for competitive advantage.

Although there has been a long stream of research on competitive advantage in the strategic management field, thus far only generic models are proposed to explain the characteristics of the sources for (sustained) competitive advantages and what can create sustainable competitive advantages. More research is needed to understand what resources are needed and how the resources interact with each other to create competitive advantages for organizations. IS researchers are more concerned with the IS resources that can contribute to an organization's competitive advantages. IS researchers have suggested the need to study specific IS, especially strategic implications of specific IS (Mukhopadhyay et al. 1995). This study aims to respond to the call by investigating the effects of business intelligence (BI) systems and their interaction with other organizational IT resources for strategic values. This study extends the competitive dynamics and IS literature by first theoretically connecting IS resources to strategic values and then empirically test how IS resources can contribute to organizations' strategic values.

2.1.3 Relationship between Competitive Action and Competitive Advantage

The relationships between competitive action, competitive advantage, and competitive performance are worthy of discussion because these relationships have been inconsistently described in prior research. Strategic research shows that competitive actions reflect an organization's strategy to achieve certain competitive advantage. However, IS research has expanded the definition of competitive action. The expansion makes the empirical results inconsistent. Competitive advantage should directly link to competitive performance, and they are almost inseparable because competitive positioning (advantage) determines organizations' ultimate performance (Porter 1980). In this section, we further discuss in the IS research context the issues that are related to the relationship between competitive action and competitive advantage.

2.1.3.1 Relationship and Measurement Issues in Extant Research

In this study, we focus on the relationship between competitive action and competitive advantage. We start by examining the definitions of these terms so that we have a common background to discuss issues. The definition of Smith et al. (1991) of competitive action emphasizes the intention to achieve or maintain competitive advantage. Their definition implies that there is a causal relationship between competitive actions and competitive advantages. This relationship between competitive action and advantage was assumed and reported in most strategic and IS research. Jacobson (1992) pointed out that competitive advantage grows fundamentally out of improvement, innovation, and change. D'Aveni (1994) found that firm performance differences can be explained not so much by their existing market positions but rather by their competitive activity (action) over time. However, some questions arise regarding the relationship between competitive action and advantage: What afford competitive actions? Is there a causal relationship between competitive advantage and competitive action? Are competitive actions themselves sufficient to create competitive advantages and increase competitive performance in all circumstances? Smith et al. (1991, pp. 61, 62) found that not all (competitive) actions will lead to successful outcomes. For example, cutting product price one time may not necessarily create a sustained competitive advantage for a company. The relationship becomes more intriguing when the definition of competitive action was expanded in the IS research, which includes internally oriented actions.

The two most common attributes of competitive action are action (repertoire) complexity and volume. The measurements for these two constructs in prior research often do not differentiate the kinds of competitive actions involved. Because of this, the causal relationship between competitive action and competitive advantage is not clear. Sambamurthy et al. (2003) and Vannoy and Salam (2010) theoretically argued that the volume of competitive actions can be a decisive antecedent to firm performances. However, empirical test results are inconsistent (Ferrier et al. 1999; Gnyawali et al. 2010). The results from the study of Gnyawali et al. (2010) show that the complexity of competitive actions has a supported positive impact on firm performance in a software firm, but the volume of competitive action does not have a consistent impact on firm performance as reported in prior research (Ferrier et al. 1999).

We believe that the reasons for the inconsistent results for the action volume variable are that (1) it is difficult to choose which competitive actions should be included in the measurements because competitive actions are largely industry-specific. If competitive actions are not carefully chosen for a specific industry, its impact on performance is questionable; (2) several competitive actions during a certain period may not be sufficient to create sustainable competitive advantages and increase an organization's competitive performances; and (3) competitive action volume usually takes all competitive actions into account. As we argued earlier, different actions can have different impacts on competitive performance or competitive advantage. So the way action volume is measured is fundamentally flawed.

2.1.3.2 Proposed Relationship between Competitive Action and Advantage

By carefully examining the definitions of competitive advantage and competitive action, we believe that the causal relationship between competitive action and competitive advantage reported in prior research requires further investigation. We adapt a broad definition of competitive action that is often used or implied in IS research. We define competitive action as any competition-related action initiated by an organization.

RBV and DCF posit that organizations have resources and dynamic capabilities that help create VRIN resources to gain and held competitive advantages. There are two kinds of competitive advantage related to VRIN resources from competitive dynamics literature: (1) cost efficiency leadership and (2) quality leadership (Hofer and Schendel 1978; Porter 1980; Teece et al. 1997). We call these competitive advantages *resource-related competitive advantage*. Another category of competitive advantage is termed as *market-related competitive advantage*, which measures the market responsiveness of an organization. This category of competitive advantages is related to Porter's (1980, 1985) industry-level competitive model that explains what industry forces affect an organization's competitive advantage. In many competitive dynamics research studies (e.g., Smith et al. 1991; Nidumolu and Knotts 1998; Ferrier et al. 1999; Ferrier 2001), market-related competitive advantage is measured.

We propose that resource-related (alternatively called internally oriented) competitive actions (Li et al. 2010) can create resource-related competitive advantages in cost efficiency and quality leadership. These competitive advantages enable organizations to carry out innovation-related (alternatively called externally or market-oriented) competitive actions, such as introducing a new product and pricing, or market-related actions, which in turn can improve their market-related competitive advantage. If an organization does not have cost-efficient competitive advantages, some of their innovation-related or market-oriented competitive actions will not be effective. We argue that an organization's resource-related competitive advantages are the foundation for innovation-related competitive actions in the long term. For example, an organization has to have product cost efficiency, a competitive advantage, to sell a product/service at a lower price, a competitive action. Otherwise, cutting prices might be a suicidal action.

Therefore, it is not a one-way causal relationship between competitive action and competitive advantage: resource-related competitive advantages are the foundation for innovation-related competitive actions; innovation-related competitive actions can improve market-related competitive advantages; and finally, resource-related competitive actions can help build resource-related competitive advantage. Only certain competitive actions can lead to certain competitive advantages. An organization that has resource-related competitive advantages can carry out innovation-related (market-oriented) competitive actions, such as cutting prices, without sacrificing firm performance, such as financial performance. Some competitive actions, such as those undertaken by organizations as part of strategic moves (e.g., resource-related actions; Li et al. 2010), can create resource-related competitive advantages. Some competitive actions, such as innovation-related (market-oriented) actions, can be undertaken by an organization if the firm has the resource-related competitive advantages.

We propose an approach to investigate the relationship between competitive action and advantage: we have to differentiate competitive actions and specifically research the kinds of competitive action and their impacts on the kinds of competitive advantage. Prior research reveals a positive relationship between competitive actions and firm performance in certain cases (Ferrier et al. 1999; Gnyawali et al. 2010; Sambamurthy et al. 2003; Vannoy and Salam 2010; Young et al. 1996). However, these results need to be assessed carefully before we can be confident that the organization's performance differences are the direct results of competitive actions. Our proposed relationship between competitive action and competitive advantage is summarized in Figure 1.

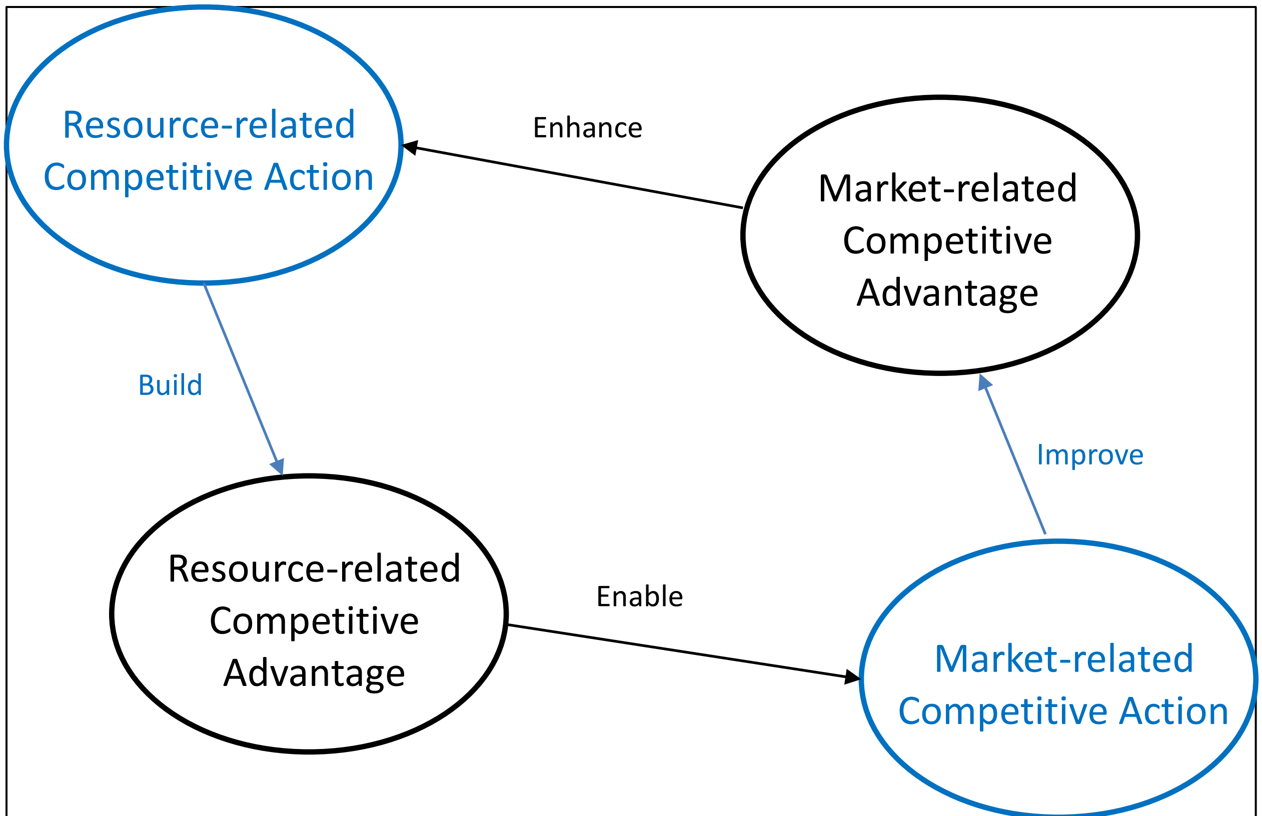

Figure 1: Relationship between Competitive Action and Competitive Advantage

In summary, we propose that (1) it is not a one-way causal relationship between competitive action and competitive advantage; and (2) as one of the characteristics of a competitive action repertoire, the action volume and complexity used in prior competitive dynamics and IS research are not reliable indicators of firm performance if the category of the actions and the kinds of firm performance are not clearly defined.

We believe that research on competitive action is still in an early stage. A formal and rigorous classification of competitive actions is needed before this construct can be used in a causal relationship. In this study, competitive advantage is chosen as the dependent variable because competitive actions may not be a reliable indicator of a company's industry position. We are interested in the factors that can help build an organization's competitive advantages. We investigate on the organizational level the factors that affect an organization's competitive advantage. As IS researchers, we need to understand the potential strategic values of IT/IS; therefore, we focus our study on IS components, such as business intelligence systems, and IT components, such as IT infrastructure.

2.2 Literature Review for the Research Model: The Independent and Moderating Variables

2.2.1 Dynamic Capability and Agility

The strategic management field has produced many fruitful research studies on the sources of competitive advantages. The resource-based view (RBV) and dynamic capability framework (DCF) are popular theories that explain competitive advantages from a firm-level perspective.

RBV is rooted in the idea that an organization can have superior economic performances if it has markedly lower costs or offers markedly higher quality or product performance (Porter 1980; Teece et al. 1997). The cost efficiency and quality of products come from scarce firm-specific resources rather than the economic profits from market positioning. This stream of thinking can be traced back to the seminal work of Penrose (1959), who views organizations as a set of resources. Wemerfelt (1984) first coined the term resource-based view of the firm. He explored the usefulness of analyzing organizations from the resource perspective but did not show the characteristics of the resources that help create superior economic performances. Barney (1991) first proposed the four empirical attributes of the potential firm resources to create sustained competitive advantage: value, rareness, imitability, and substitutability. RBV has been used in IS research to explain IT/IS business values (e.g., Li et al. 2010; Nevo and Wade 2010).

Although Barney (1991) believes that firm resources with these four characteristics can help create sustained competitive advantage, dynamic capability researchers (e.g., Teece and Pisano 1994; Teece 2007) argued that these resources have a static nature and can only generate competitive advantage for the current time, not for the long term (sustained competitive advantage). They proposed that a sustained competitive advantage comes from an organization's capability to integrate and reconfigure internal and external resources to respond market opportunities and threats. Teece and Pisano (1994) proposed the dynamic capability framework to explain how a competitive advantage is gained and held. They argued that competitive advantages of organizations stem from dynamic capabilities, which include timely responsiveness, and rapid and flexible product innovation, along with the management's ability effectively to coordinate and redeploy internal and external competences. Teece et al. (1997) theoretically argued the direct link between dynamic capability and competitive advantage.

Dynamic capability literature prescribed several dimensions of dynamic capability and their micro-foundations (Teece 2007). Those dimensions include (1) sensing (and shaping) opportunities and threats, (2) seizing opportunities, and (3) managing threats and reconfiguration. From the definition of dynamic capability, speed is not specifically viewed as a key dimension or property of capability. But speed is a key measurement for agility. In a rapidly changing environment, speed is clearly a critical factor that can influence an organization's performance.

Based on the prior definitions of agility from D'Aveni (1994) and Goldman et al. (1995), Sambamuthy et al. (2003, p. 245) defined agility as "the ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge, and relationships with speed and surprise." Li et al. (2008) reviewed the agility literature and defined agility based on two factors: "the speed and the capabilities of the firm to use resources to respond to changes." Holsapple and Li (2008) also identified two dimensions of agility: alertness and responsiveness. In short, these definitions of agility in the business context indicate that agility is an organization's ability to sense/detect (alertness) and act/respond (responsiveness) to changes with speed. The two key dimensions of agility are the ability to detect environmental changes with speed and the ability to respond to environmental changes with speed.

Sambamurthy et al. (2003) argued that organizational agility comprises three interrelated capabilities: customer agility, partnering agility, and operational agility. In general, the categorization by Sambamurthy et al. (2003) implies that organizational agility has three dimensions: customer, partner, and operation. Sambamurthy et al. (2003, p. 245) defined customer agility as "the co-opting of customers in the exploration and exploitation of opportunities for innovation and competitive action moves." Their definition of customer agility is narrowly related to the cocreation of new ideas, products, and services. We see customer agility in a broader sense as an organization's ability to sense and respond to customer changes in demand for products and services in a turbulent environment. Based on Venkatraman and Henderson's (1998) research, Sambamurthy et al. (2003, p. 245) defined partner agility as the "ability to leverage the assets, knowledge, and competencies of suppliers, distributors, contract manufacturers, and logistics providers through alliances, partnerships, and joint ventures." Operational agility is about the ability of an organization's operation processes to innovate and compete with speed, accuracy, and cost effectiveness. We use these dimensions to examine the measurement indicators for collecting data for this study.

From the discussion of dynamic capability and organizational agility, we propose that organizational agility, a term often used in the IS research context, is an organizational dynamic capability, a term often used in the strategic management research context. The term agility used in the IS context indicates the ability to sense and respond to opportunities and threats in business environments in timely and cost-effective fashion. The term organizational agility used in the IS research places emphasis on speed, whereas the term dynamic capability used in the strategic management research stresses less on speed.

Prior IS research has established the direct link between organizational agility and competitive performance (Sambamuthy et al. 2003; Lee et al. 2008). Our literature review on strategic management research also reveals that agility is a key contributor to competitive advantage. For example, Zaheer and Zaheer (1997) introduced the constructs of alertness and responsiveness, the two dimensions of organizational agility, and how organizations with substantial alertness and responsiveness can apply higher market influence, which is a competitive advantage, in their industries. Based on the dynamic capability framework and prior IS and strategic management research on agility and competitive performance, this study suggests that (1) organizational agility is a dynamic capability with emphasis on speed and (2) there is a positive relationship between organizational agility and competitive advantage.

Research on dynamic capability from the strategic management field provides the theoretical foundation for why organizational agility, which has been studied in the IS field for decades, is a critical competitive factor and is a source for competitive advantage.

2.2.2 IT Infrastructure Flexibility

In many operations management and IS research works, there is no distinction between agility and flexibility, or when those terms were used, no definitions were provided. Often, those two terms were used interchangeably in many research papers. Nevertheless, agility and flexibility are defined differently in many other research papers (see agility definitions in D'Aveni (1994), Goldman et al. (1995), Sambamuthy et al. (2003); see flexibility definitions in Duncan (1995) and Byrd and Turner (2001)).

Flexibility is broadly defined as the degree to which a thing is malleable. It refers to the ability to quickly and economically adapt the IS applications to changing business requirements in the IS context (Kumar 2004; Schlueter 2006). Flexibility has been viewed as one of the firm's capabilities that have influences on the firm's speed to act or respond (Yusuf et al. 1999; Zhang and Shariff 2000; Tiwana and Konsynski 2010) and as an antecedent of agility (Swafford et al. 2006). Although flexibility could lead to quick action, flexibility has other aspects that are not related to speed. For example, an inflexible IT system can be quickly reconfigured to respond to changes but with significant cost to do so. Thus, agility and flexibility are two different constructs. Agility is about the speed to detect/sense or respond to opportunities and threats in the business context. Flexibility is about malleability and the ability to help respond to change requests quickly and economically and is a key antecedent of agility in the business context (Li et al. 2008; Tiwana and Konsynski 2010).

IT infrastructure is consistently defined in literature as a set of shared IT resources that are a foundation for enabling communication across an organization and enabling present and future business applications (Niederman et al. 1991; Duncan 1995; Byrd and Turner 2001). It not only includes the technological components but also the human components (Duncan 1995; Chanopas et al. 2006). IT infrastructure flexibility refers to the degree to which the firm's IT resources are malleable (Duncan 1995). The definition of IT infrastructure flexibility by Byrd and Turner (2001) and Byrd (2001) emphasizes IT infrastructure's ability to easily and readily support a wide variety of hardware, software, and communication technologies, to distribute information to anywhere inside an organization and beyond, and to support the design, development, and implementation of a heterogeneity of business applications. Four key components of IT infrastructure flexibility have been identified in the literature. Connectivity, compatibility, modularity, and IT personnel competency were first identified by Duncan (1995) and Byrd and Turner (2001). Mishra and Agarwal (2010) added organizational cognition of IT technologies (technological frame) as another component of IT infrastructure flexibility. However, most commonly accepted dimensions of IT infrastructure flexibility are connectivity, compatibility, and modularity.

This study reviews the definitions of agility and flexibility and clarify the differences between the two frequently used constructs in IS literature. Scholars in IS field has studied IT infrastructure flexibility as an independent variable (Broadbent et al. 1999; Byrd and Turner 2001; Chung et al. 2003; Tiwana and Konsynski 2010) and as a moderator (Lin 2010; Tallon and Pinsonneault 2011). However, to the best of our knowledge, there is no empirical study in the IS research that directly investigates the relationship between IT infrastructure flexibility and organizational agility, especially from the organizational agility perspective. Kumar (2004) proposed that the real values of IT infrastructure flexibility lie in the flexible interaction between an IT infrastructure and its organizational context. This study extends that proposition by specifying to what organizational capability IT infrastructure flexibility contributes. This study emphasizes that IT infrastructure flexibility is a contributing factor to the improvement of organizational agility: flexibility contributes to the responding dimension of agility; therefore, IT infrastructure flexibility has strategic values through organizational agility. This study uses the key components of IT infrastructure flexibility identified in the IS literature to develop survey instruments to measure IT infrastructure flexibility.

2.2.3 Business Intelligence

Business intelligence (BI) is a new business-driven phenomenon that can add values for organizations. Watson (2009) defined BI as "a broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make better decisions." This study adopts the broad definition of BI. At the conceptual level, BI is an umbrella term for systems and procedures that transform raw data into useful information for managers to make better decisions (Wixom and Watson 2010). At the operational level, BI is an information system that has three elements (Laursen and Thorlund 2010): (1) a technological element that collects, stores, and delivers information and includes the general technology of BI that performs basic functions to support generic actions in BI: gather, store, access, and analyze data; (2) a human competencies element on the abilities of human beings to retrieve data and deliver it as information, to generate knowledge, and to make decisions based on the new knowledge. Although the basic functions of BI are provided, human operators still need to have certain knowledge/competency to retrieve data and generate reports and make decisions based on those reports and (3) a third element that supports specific business processes that make use of the information or the new knowledge for increasing business values. This element includes special functions of BI. For example, a supply chain BI system is designed to provide supply chain–related information so that users of the system can set up automatic responses when certain conditions have been reached (e.g., replenish inventory when the volume of certain items in stock lowers to a predefined number). This third element is the advanced feature of a BI system. It makes a BI system more than a reporting application (Laursen and Thorlund 2010). However, this third element is not the focus of this study.

Jourdan et al. (2008) reviewed the BI research studies published before 2006. One finding of their study is that BI research conducted before 2006 focused primarily on exploratory research, formal theory and literature review, and very little empirical research were conducted. The other intriguing finding is that prior research only addressed new technologies and issues in BI, without attempting to explain the fundamental issues of IS research as it relates to BI, such as generalizability (external validity), precision of measurements (internal and construct validity), and realism of context.

Although competitive intelligence (CI) was used in the study by Wright et al. (2009), we believe CI is part of BI. Some other BI-specific issues have been studied in recent years: critical success factors (Yeoh and Koronios 2010), intelligence strategy (Johannesson and Palona 2010), and intelligence maturity model (Lahrmann et al. 2011). Prior literature also includes a few studies on BI and its contextual factors. For example, Muller et al. (2010) studied BI functions and how service-oriented architecture could help those functions. Seah et al. (2010) conducted a case study on culture and leadership's role in BI implementation. Trkman et al. (2010) performed a survey study on the impact of BI on supply chain performance. Elbashir et al. (2011) researched the organizational capabilities that help BI assimilation. Marjanovic and Roose (2011) carried out a case study to investigate how to integrate BI into business process improvement. Laursen and Thorlund (2010) provided an excellent illustration on what business intelligence is and how it should be carried out at different levels of organization: strategic level (strategic initiatives) and operational level (business process changes). These papers, however, did not address how complementary resources affect BI contribution to an organization's competitive performance and/or general firm performance and therefore did not address the question of why organizations need to be BI based.

BI is not a new concept. Its history can be traced back to the 1950s, when it was first formally introduced by Luhn (1958). For example, the decision support system (DSS), expert systems, and online analytical processing are early versions of BI systems (Wixom and Watson 2010). In the 1990s, the term BI was coined by Gartner analysts to describe these early versions of BI systems and eventually became popular. In the late 2000s, BI was a top-priority agenda according to Gartner (2008, 2009) and was the top application and technology under development in 2009 (Luftman and Ben-Zvi 2010). BI skills are at the top of the list of highly pursued skills (Brandel 2009). Since the late 2000s, BI has become a new information systems (IS) fashion, which is defined as "a transitory collective belief that an information technology is new, efficient, and at the forefront of practice" (Wang 2010). When studying the diffusion of IT innovation and impact of IT fashion on organizations, Wang (2010) suggests that the middle stage of the diffusion of an IT innovation is critical. This middle stage is when an IT innovation is in fashion among business managers. In this stage, IT fashion has not been proven to deliver its full benefits and most adopters are still trying to realize the claimed benefits. It is uncertain whether BI implementation can deliver and how BI delivers the benefits that idea entrepreneurs (e.g., consultants, gurus, journalists, and vendors) claim it can deliver. Early studies show that some companies benefited from the investment in BI (Watson et al. 2006) and some did not (Gessner and Volonino 2005). The question for organizations engaging in BI is "Is BI an enduring fashion (next big thing) or a passing fad?" This is a critical question since BI requires large financial and human capital investment and business process changes.

Wang (2010) stated that prior studies on IT fashions, such as the study on business process reengineering (BPR) by Newell et al. (1998) and the study on ERP by Wang and Ramiller (2009), were primarily focused on the emergence and evolution of the IT fashions, but the studies fell short in demonstrating the significance of the IT fashion. As pointed out by Jourdan et al. (2008) and our own literature review, BI research is still in its infancy (exploratory) stage. Theoretically, BI has been argued as the next big thing in information technology, but empirical research on the significance of BI is very limited. Wang (2010) argued that to justify an IT fashion as a worthy innovation to study, the organizational consequences of the IT fashion must be studied.

This study uses cross-sectional data to assess the impact of BI use on organizational agility and on competitive advantages. This study will provide empirical evidence on the significance of BI use in different business environments. The empirical results can shed light on whether BI will have the potential to deliver the benefits it promises. If BI can contribute significantly to organizational agility, which has been demonstrated theoretically and empirically to be significant for competitive advantages and performances (Benaroch 2002; Sambamurthy et al. 2003; Fichman 2004; Benaroch et al. 2006; Tallon and Pinsonneault 2011), it can be claimed that BI at least has the potential to be an enduring technology fashion.

The aim of this study is to investigate the significance of BI by empirically demonstrating the way BI can help organizations. From the organizational agility perspective, this study proposes that BI is a contributing factor to agility. BI can help increase an organization's ability to sense and detect environmental changes. Through agility, BI can help increase an organization's competitive performance and become a strategic force for improving competitive advantage.

2.2.4 Environmental Turbulence

In the integrative model of IT business value, Melville et al. (2004) emphasized the impacts of industrial characteristics on the relationship between IT-enabled resources and firm performance. Dess and Beard (1984) defined a turbulent business environment as the frequency and extent of change in critical market variables. These market variables may include changes in market conditions and technology (Jaworski and Kohli 1993). A turbulent environment is also referred to as a hypercompetitive environment (Mithas et al. 2011) and generally defined as "general conditions of uncertainty" (Rai and Tang 2010, p. 521).

El Sawy and Pavlou (2008, p. 139) characterized a turbulent environment with "unpredictability arising from unexpected changes in market demand and consumer preferences, new technology developments, and technological breakthroughs." They found that there are three types of capabilities that influence strategic advantage in such turbulent environments: (1) operational (ability to execute processes), (2) dynamic (the planned ability to reconfigure operational capabilities), and (3) improvisational (the learned ability to spontaneously reconfigure operational capabilities). The last two capabilities are dynamic capabilities in general; therefore, there is a connection between the dynamic capability and competitive advantage that can be influenced by environmental turbulence. This position has been proposed and tested in many other IS and competitive dynamic research (Jaworski and Kohli 1993; Pavlou and El Sawy 2006; Johannesson and Palona 2010; Rai and Tang 2010; Mithas et al. 2011; Tallon and Pinsonneault 2011)

As argued in the prior section, organizational agility is a dynamic capability with emphasis on speed; therefore, in a turbulent environment, organizational agility is a force that will influence strategic advantage. It implies that in a less turbulent environment, organizational agility may not be that important in influencing strategic advantage. In general, it is agreed that IT creates value under certain conditions (Kohli and Grover 2008).

How a turbulent environment moderates BI's value has not been thoroughly researched. Current research also lacks in the IS research on how a turbulent environment moderates the impact of IT infrastructure flexibility on organizational agility. This study investigates the impact of BI and IT infrastructure flexibility on competitive performance and is the first empirical study that examines how environmental turbulence influences those impacts.

Chapter 3

Theoretical Foundation

The following sections describe the theories that helped us develop our research model and hypotheses. These theories interweave with each other to form a theoretical foundation for explaining why the research model is valid in theory.

3.1 Systems Theory and Organizational Agility

Nevo and Wade (2010) systematically reviewed the systems theory and asserted (p. 165) that (1) the world is made up of things; (2) things possess properties; and (3) each property is represented by some value at any point in time. The systems theory defines systems as composite things. Systems possess properties that are derived from the interaction among the composing components (Von Bertalanffy 1968; Ackoff 1971; Checkland 1981). Extending the systems theory, Nevo and Wade (2010) proposed that "some system properties may be properties of their components but with new values," whereas "other system properties are new in the sense that no individual component possesses them in isolation" (p. 166). Those system properties are called emergent properties (Nevo and Wade 2010). This study uses the systems theory and the concept of emergent properties from Nevo and Wade (2010) to propose that organizational agility is an emergent property whose value comes from two sourcing components and the interacting relationship between the two components. One of the sourcing components is the component that senses and detects environmental changes and the other is the component that acts on and responds to environmental changes.

3.2 Resource-Based View of the Firm

The resource-based view (RBV) of the firm is a firm level model to describe competitive advantage. It is developed to emphasize firm-level–specific capabilities and assets (resources) that underline a firm's competitive advantage (Penrose 1959; Wernerfelt 1984; Mahoney and Pandian 1992). Barney (1991) proposed four empirical characteristics of organizational resources that can help build an organization's competitive advantage. Resources need to be valuable, rare, inimitable, and nonsubstitutable (VRIN) to create competitive advantages for organizations that own those resources. RBV has been criticized with its static nature (Teece et al. 1994; Eisenhardt and Martin 2000; Teece 2007). However, RVB provides a lens to view organizations and their competitive advantages at a certain point in time. This study views organizational agility as an intangible VRIN resource that organizations need to own to compete in a highly competitive environment. However, organizational agility is not a static resource. It will evolve over time and will help build other VRIN resources to generate competitive advantages.

3.3 Dynamic Capability Framework

The construct of dynamic capability was first introduced by Teece et al. (1997). In their seminal work on dynamic capability, Teece et al. (1997) argued that VRIN resources are the elements that undermine a firm's current competitive advantage, not sustained competitive advantages. The dynamic capability framework was proposed to explain how organizations gain and hold sustainable competitive advantages (Teece et al. 1997). They noted that a competitive advantage requires the exploitation of existing internal and external firm-specific capabilities and developing new ones. VRIN resources are just one of the factors for current advantages, but dynamic capability is the one factor for developing new firm-specific capabilities for competitive advantages. Dynamic capability framework states that VRIN resources are not enough for organizations to gain superior return in the long term in a highly competitive environment. The ability to develop new VRIN resources is the key factor for sustained competitive advantages. Teece (2007) further explicated the construct of dynamic capability and emphasized that dynamic capabilities can help organizations create, deploy, and protect the intangible assets (VRIN resources) for long-term business performance (sustained competitive advantages). Originally, routines and processes are viewed (Teece et al. 1997) as the capabilities to help develop new resources to keep an organization ahead of competitions. Later Eisenhardt and Martin (2000) and Teece (2007) redefined dynamic capability as capabilities to integrate and reconfigure internal and external resources to respond to market opportunities and threats. An organization's ability to integrate, build, and reconfigure its internal and external resource will help the organization gain a sustained competitive advantage. This study views organizational agility as a dynamic capability that serves as an intangible VRIN resource and the ability to sense/detect and act/respond to environmental changes for lasting competitive advantage.

3.4 Awareness-Motivation-Capability Framework

The awareness-motivation-capability (AMC) framework was first introduced by Chen (1996). It is traditionally used in competitive dynamics research to study the antecedents of competitive actions. The awareness-motivation-capability perspective suggests that three behavioral drivers influence a firm's decision to act or respond: awareness, motivation, and capability (Chen 1996). Chen at al. (2007) argued that in competitive dynamics research, individual awareness-motivation-capability components are manifested in a range of variables, including action visibility and firm size for awareness; territorial interests in different markets (Gimeno 1999) for motivation; and execution difficulty and information processing (Smith et al.

1991) for capability. This lens provides us a theoretical hoop to integrate the digital systems into the competitive dynamics: what are the roles of IT systems and its characteristics in competitive performance. It also provides theoretical supports on why business intelligence systems and IT infrastructure flexibility have the potential impact on competitive advantage. Business intelligence can help raise the awareness of opportunities and threats in marketplaces, and then response motivations follows. IT infrastructure flexibility can help an organization's capability to respond to opportunities and threats in marketplaces. It is a part of an organizational capability to respond. AMC framework further illustrates the roles of business intelligence and IT infrastructure flexibility in building agile organizations that can compete effectively and successfully. Therefore, the AMC framework helps define the roles of IT/IS components in creating competitive advantage.

Chapter 4

Research Model and Hypothesis Development

4.1 Research Model

Drawing on the dynamic capability framework and current literature on BI, IT infrastructure flexibility, organizational agility, and competitive performance, this study developed a research model as shown in Figure 2.

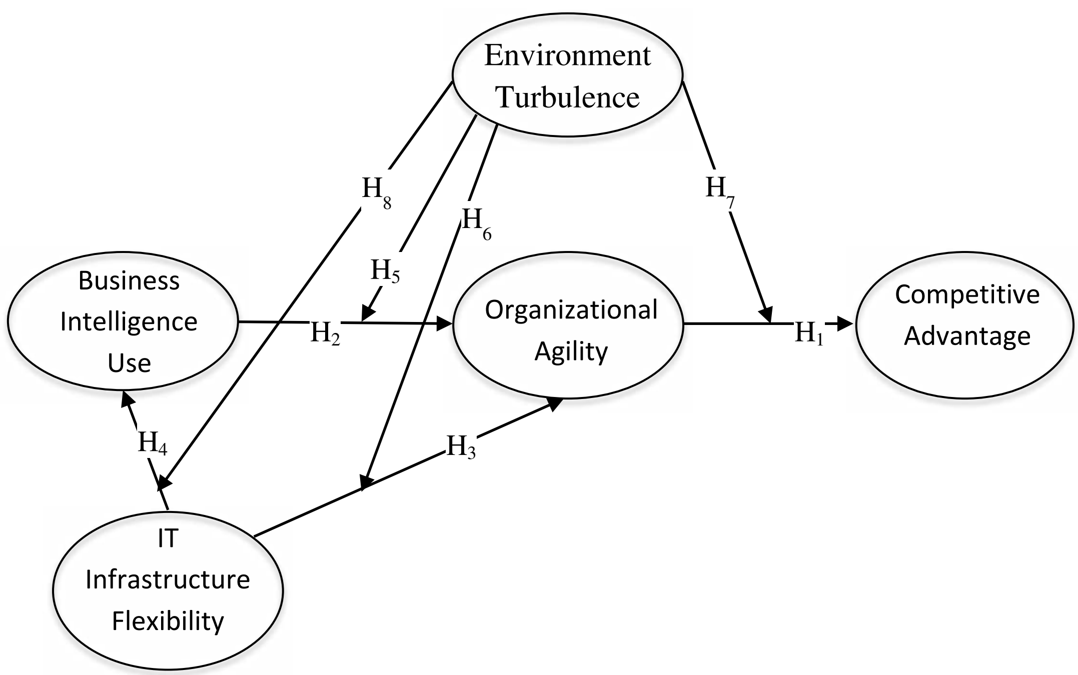

Figure 2: Conceptual Model (Structural Model)

4.2 Hypotheses Development

4.2.1 Relationship between Organizational Agility and Competitive Advantage

As mentioned in the literature review section, the dynamic capability framework (Teece et al. 1997) theoretically argues that there exists a direct link between an organization's dynamic capabilities and competitive performance.

Teece et al. (1997) first defined dynamic capability as the routines and processes that integrate or reconfigure existing resources to create new resources that hopefully have strategic values. Using dynamic capabilities, organizations can build VRIN resources that are strategically critical in a competitive environment. Dynamic capability needs to act upon other operational capability and resources to improve/change/initiate other organizational resources (Helfat and Peteraf 2003, p. 1004). However, in later theses, dynamic capability is further developed and slightly refined as an ability to build, integrate, or reconfigure internal and external resources to address changing environments (Eisenhardt and Martin 2000) or as an ability to sense and shape opportunities and threats, to seize opportunities, and to maintain competitiveness through enhancing, combining, protecting, and when necessary, reconfiguring the organization's resources (Teece 2007). However, these definitions do not emphasize the factor of speed.

Organizational agility has been defined as the ability to detect and respond to opportunities and threats with ease, speed, and dexterity, and speed has been emphasized for agility in various IS research papers (Li et al. 2008, p. 421; Sambamurthy et al. 2003, p. 238; Tiwana and Konsynski 2010, p. 294; Tallon and Pinsonneault 2011). Eisenhardt and Martin (2000) discussed some specific dynamic capabilities. Examples (p. 1107) include, but are not limited to, (1) dynamic capability to integrate resources, such as product development routines; (2) dynamic capabilities to reconfigure resources within organizations to build new resources, such as copy, transfer, and recombine resources, especially knowledge-based resources; and (3) dynamic capabilities to gain and release resources, such as knowledge creation routines to build new thinking, alliance, and acquisition routines that bring new resources and exit routines to release resources that no longer provide competitive advantages. From the definitions of organizational agility in the IS literature and dynamic capability in the strategic management literature and the researchers' elaboration on these concepts, we argue that organizational agility is a dynamic capability that detects opportunities and threats and reconfigures internal and external resources to respond to those opportunities and threats with speed. This connects organizational agility to dynamic capability and provides a basis to argue for and support the claim in the IS literature that organizational agility has strategic value and can be the antecedent to competitive advantage.

Based on the review of the strategic management and IS literature, we hypothesize the relationship between organizational agility and competitive advantage as follows:

H_1: An organization's agility will positively impact its competitive advantage.

4.2.2 Relationship between Business Intelligence Use and Organizational Agility

Based on the systems theory, organizations are systems. Organizational agility is an emergent property of organizations. According to the definition of organizational agility, the value of organizational agility comes from two dimensions: one is sensing/detecting and the other is acting/responding to environmental change. We further argue that the use of BI in organizations will help increase organizational agility by improving an organization's ability to sense/detect environmental changes.

The BI's contribution to organizational agility can also be found in the current IS research on the topic. The construct of information management capability (IMC) by Mithas et al. (2011) is an encompassing construct that includes functions provided by BI. They defined IMC as the ability to (1) provide data and information to users with appropriate levels of accuracy, timeliness, reliability, security, and confidentiality; (2) provide universal connectivity and access with adequate reach and range; and (3) tailor the infrastructure to emerging business needs and direction. Mithas et al. (2011) found significant positive influences of IMC on three organizational capabilities: performance management capability, customer management capability, and process management capability.

In this research, we study the relationship between BI and organizational agility, which includes customer agility, partner agility, and operation agility (Sambamurthy et al. 2003). Customer agility is an essential part of customer management capability, and operational agility is a part of the process management capability proposed by Mithas et al. (2011). Therefore, we have reasons to postulate that BI use can enhance an organization's agility. Furthermore, business intelligence collects, analyzes, and presents interpreted information to organization managers to help them make the right decision at the right time. Business intelligence can help organizational agility by detecting customer event patterns, identifying operational opportunities and bottlenecks, and revealing changes in partners' assets and competencies to managers so that they can sense, act, or make timely decisions.

The strategic IT alignment literature also provides support on the positive effect of business intelligence on organizational agility. For example, knowledge creation, sharing, and use have been studied as enablers of strategic IT alignment (Reich and Benbasat 1996; Kearns and Lederer 2003; Preston and Karahanna 2009). Owing to knowledge sharing between business and IT executives, an organization can quickly respond to changes in market places and thus increase an organization's agility. Knowledge creation, sharing, and use are the underlying arguments for the positive effect of strategic IT alignment on agility (Tallon and Pinsonneault 2011). Because business intelligence is an information system that helps managers make the right decisions at the right times, it is used across business units. It can create an environment for sharing newly found/created knowledge.

Therefore, theories suggest the following hypothesis:

H_2: Business intelligence use will positively impact an organization's agility.

4.2.3 Relationship between IT Infrastructure Flexibility and Organizational Agility

Because contemporary organizations mostly are IT enabled, organizational capabilities are often inseparable from IT (Ferrier et al. 2007; Pavlou and El Sawy 2010). Today organizational actions are rarely executed without information technology. IT infrastructure flexibility provides the means for IT departments to quickly respond to change requests from functional lines of business. From the systems theory perspective, IT infrastructure flexibility is another IT-related contributing source component to organizational agility because a flexible IT infrastructure can help organizations to integrate and reconfigure internal and external resources quickly and economically to respond to change requests. IT infrastructure flexibility, together with business functional lines' process agility, can improve an organization's ability to respond to or act on changes in competitive environments whether the changes are from customers, partners, or operations. Prior research studies (Rai et al. 2006; El Sawy and Pavlou 2008; Bush et al. 2010) support this view about the positive role of IT infrastructure flexibility to quickly integrate and reconfigure internal and external resources to respond to changes.

Theoretically, Sambamurthy et al. (2003) argued that there is a positive relationship between IT infrastructure flexibility and organizational agility. Although there is a lack of empirical studies in the IS literature on the direct relationship between IT infrastructure flexibility and organizational agility, there are research works that established the direct link between flexibility and agility in general (Yusuf et al. 1999; Zhang and Shariff 2000; Tiwana and Konsynski 2010).

Therefore, our theoretical argument from the organizational agility perspective and the IS literature suggests the following hypothesis:

H_3: IT infrastructure flexibility will positively impact organizational agility.

4.2.4 Relationship between IT Infrastructure Flexibility and Business Intelligence Use

Business intelligence systems are information systems built on top of existing IT infrastructure in digitally enabled organizations. Business intelligence systems require access to data from a variety of sources and distribute data to different user and data interfaces, such as Web browsers on desktop computers, small screens on mobile devices, or as a data feed to other information systems. A flexible IT infrastructure can help business intelligence easily and quickly access or integrate existing and new data sources. A flexible IT infrastructure can also help distribute data and information to different distributing channels and receiving devices. It is reasonable to argue that a flexible IT infrastructure can increase business intelligence use because with a flexible IT infrastructure, more information can be readily available when needed and coveted information can be available where and when it is needed. The rich and accurate information can make business intelligence systems be perceived as more useful. The established technology acceptance model (TAM; Davis 1989; Venkatesh and Davis 2000) suggests that the perceived usefulness of an information system will encourage the use of the information system. Therefore, our next hypothesis is

H_4: IT infrastructure flexibility will positively impact BI use.

4.2.5 Moderating Effects of Environmental Turbulence

One theme that is common for the discussed constructs is speed. Organizational agility is about the speed to sense and respond to changes. BI is about helping managers make the right decision at the right time quickly and increasing organizational agility. IT infrastructure flexibility is about making the IT infrastructure malleable to quickly adjust to the ongoing changes in business environments. Obviously, the speed requirement varies among industries. An Internet company is probably more sensitive to customer changes than an educational institution. Therefore, a turbulent environment or a quickly changing environment in terms of customer demands and preferences will require organizations to respond more quickly and cost effectively to increase competitive advantages and to stay afloat.

Although El Sawy and Pavlou (2008) mentioned that the IT infrastructure capabilities affect dynamic and improvisational capabilities in turbulent environments, the things that they showed IT infrastructure could help were also the things that could be helped by BI (e.g., effectively sensing the environment; acquiring, assimilating, and using knowledge by effectively coding, synthesizing, and sharing knowledge to generate new learning; and making information visible and accessible). Turbulent environments create more opportunities or crises for companies competing in them. BI can help organizations quickly sense those opportunities and threats. In turbulent environments, organizations will rely more on BI to sense and more on IT infrastructure flexibility to respond to opportunities and threats. Turbulent environments will amplify the effects of BI and IT infrastructure flexibility on organizational agility and in turn intensify the effects of organizational agility on competitive advantage. In a highly turbulent environment, a flexible and adaptable IT infrastructure is more valuable than in a less turbulent environment in providing supports for integrating data from different parts of operation to help managers make right decisions. We see that turbulent environments impact the relationships between BI use, IT infrastructure flexibility, organizational agility, and competitive advantage. Therefore, our next four hypotheses are as follows:

H_5: Environmental turbulence will reinforce the positive impact of BI use on organizational agility.

H_6: Environmental turbulence will reinforce the positive impact of IT infrastructure flexibility on organizational agility.

H_7: Environmental turbulence will reinforce the positive impact of organizational agility on competitive advantage.

H_8: Environmental turbulence will reinforce the positive impact of IT infrastructure flexibility on BI use.

4.2.6 Indirect Effects of IT Infrastructure Flexibility and Business Intelligence Use on Competitive Advantage

We have theoretically argued earlier that IT infrastructure flexibility and business intelligence use are contributing components to organizational agility. Based on the process view of organizations and Porter's value chain model, Pavlou and El Sawy (2006) proposed that dynamic capabilities in a new product development context are resource-enabling primary activities because they are directly involved with products and services development and IT leveraging competences are resource-enabling secondary activities. IS-related functions have been viewed as the platform on which other higher-order organizational capabilities can be built (Grant 1995). Citing Grant's (1995) suggestion, Pavlou and El Sawy (2006) stated, "the higher the order of firm capabilities, the more immediate is their impact on competitive advantage." We agree with that suggestion and applied the concept in this study. We posit that organizational agility is a critical higher-order organizational capability in creating competitive advantage because, as argued in the literature review section, organizational agility is a dynamic capability with emphasis on speed and it helps develop products and services that meet customer demands. We also propose that IT infrastructure flexibility and business intelligence use are capabilities and resources that enable organizational agility. IT infrastructure flexibility and business intelligence systems are the platform on which organizational agility can be built. Therefore, IT infrastructure flexibility and business intelligence use do not directly affect competitive advantage but, through organizational agility, have indirect impacts on competitive advantage.

Our next two hypotheses are as follows:

H_9: The impact of IT infrastructure flexibility on competitive advantage is mediated by organizational agility.

H_{10}: The impact of business intelligence use on competitive advantage is mediated by organizational agility.

Chapter 5

Research Method

A cross-sectional survey study was employed to test the research model. This chapter discusses the survey instrument developed to measure the constructs in the research model, the sample group, the participants' characteristics, the data collection process, and the statistical analysis technique used to analyze the data..

5.1 Cross-sectional Survey Study

A survey is a non-experimental research method. It is "a means of gathering information about the characteristics, actions, or opinions of a large group of people, referred to as a population" (Pinsonneault and Kraemer 1993, p. 77). Survey research is among the most common methodologies employed in MIS research. Survey research has been recommended as an appropriate method and is a typical research method for testing models in social science studies (Babbie 1990; Pinsonneault and Kraemer 1993). Survey research is employed for two different purposes: exploratory and explanatory. Exploratory survey research tries to answer the question "what is" or "what was" (Hedrick et al. 1992; Pinsonneault and Kraemer 1993). Explanatory survey research tries to answer the question "why" and to test theory and causal relationship (Pinsonneault and Kraemer 1993; Neuman 2003). Pinsonneault and Kraemer (1993, p. 80) pointed out that "the central research question in explanatory survey research is: 'Does the hypothesized causal relationship exist, and does it exist for the reason posited?'" This research is an explanatory survey research. It employed the survey method to test the research model that is based on multiple theories in IS research.

A cross-sectional survey is one of the two main designs in survey methodology. It provides a snapshot of the interested variables in a study at one particular point in time. We found that the cross-sectional survey method is appropriate for this study because we are interested in the current state of business intelligence use and its impact on an organization's current organizational agility and competitive advantage.

5.2 Survey Instrument Development

This study uses the existing survey instrument whenever it is possible. The existing measurement scales were examined according to well-recognized and standard scale development procedure, such as the procedure proposed by Churchill (1979). Specifically, we examined if an instrument's reliability has been properly checked in a study that developed the instrument. Then, we checked if the instrument's validity check had been performed in the study, which should include content, determinant, and convergent validity. The high reliability and validity of an instrument are essential for a high-quality survey instrument.

For the new instrument developed in this study, we followed the same procedure proposed by Churchill (1979). We developed the instrument for the business intelligence system usage construct. All instruments for other constructs used in this study are adapted from existing instruments.

5.2.1 Scale for Business Intelligence Use

To develop the BI usage instruments, we refer to Burton and Straub's (2006) discussion on system usage. They proposed that system usage is an activity that involves three elements: a user, a system, and a task. Therefore, they defined individual-level system usage as an individual user's employment of one or more features of a system to perform a task. A staged approach was recommended for conceptualizing system usage. There are two stages to define an information system usage. The first is definition stage. This stage defines the distinguishing characteristics of system usage and state assumptions regarding these characteristics. The second is select stage. This stage chooses the best measures for the part of the usage activity that is of interest. There are two steps in the second stage:

Step 1: Build structure: select the elements of usage that are most relevant for the research model and context.

Step 2: Define function: select measures for the chosen elements that are tied to the other constructs in the nomological network.

For executives in organizations, their usage of BI can be classified as exploitive usage that refers to "usage that implements and executes one's knowledge of one's system and task" (Burton and Straub 2006, p. 236). The exploitive usage can be captured by two subconstructs: cognitive absorption, which represents the extent to which a user is absorbed, and deep structure usage, which represents the extent to which features in the system that relate to the core aspects of the task are used (Burton and Straub 2006, p. 236). We believe that cognitive absorption is more related to individual task performance than to how much a system is used by a user.

Our measurement indicators for BI use are mostly in the deep structure usage category. We first selected features of BI information systems that will be used by users. Then, we combined the selected features with corresponding tasks to measure the extent of BI use in an organization. The selected features are based on the inputs from academic researchers and industrial trade papers. We developed the instrument based on the features provided by industrial groups, such as the features discussed in the report provided by The Data Warehousing Institute (Eckerson 2009). We further refined the features and the instrument with helps from several academic researchers who have done various researches on BI and taught BI classes in universities.

A convenience sample of twenty-two business and IT staff from various industries, as well as three IS researchers, were selected to pilot test the questionnaire to further refine the measurement scale. We also used the pilot study to ensure the survey Web site was functioning as expected.

The reliability of the developed scale for business intelligence use was assessed using Cronbach α and composite reliability scores. The recommended threshold score is 0.7 for Cronbach's α and composite reliability (Fornell and Larcker 1981; Nunnally and Berbstein 1994; Chin 1998a; Hulland 1999; Kline 2005). An instrument with this score or above for Cronbach's α and composite reliability indicates the internal consistency of reliability of the instrument indicators. The determinant and convergent validities of the measurement scale were also assessed using recommended statistic tests.

5.2.2 Scale for IT Infrastructure Flexibility

We developed our indicators for measuring IT infrastructure flexibility based on the scales from Duncan (1995), Byrd and Tuner (2000), Tiwana and Konsynski (2010), and Tallon and Pinsonneault (2011).

Duncan (1995) first summarized the concept of IT infrastructure flexibility and empirically showed how IT executives view IT infrastructure flexibility. Duncan (1995) found three flexibility qualities. They are connectivity, compatibility, and modularity. Byrd and Tuner (2000) defined the three proposed dimensions of IT infrastructure flexibility by Duncan (1995). Connectivity is "the ability of any technology component to attach to any of the other components inside and outside the organizational environment; compatibility is the ability to share any type of information across any technology component; and modularity is the ability to add, modify, and remove any software, hardware, or data components of the infrastructure with ease and with no major overall effect" (Byrd and Tuner 2000, p. 171). Byrd and Tuner (2000) also offered the operationalization of the three dimensions of IT infrastructure, which become the base for later measurement scale, such as the one used by Tallon and Pinsonneault (2011). Tiwana and Konsynski (2010) proposed to include the IT standardization as a subdimension for measuring IT modularity. Standardization refers to "the degree to which organization-wide standards and policies pre-specify how applications in an organization's IT portfolio connect and interoperate with each other" (Tiwana and Konsynski 2010, p. 3). Our measurement scale includes the standardization indicators in the IT infrastructure modularity dimension.

Byrd and Tuner (2000) and Tallon and Pinsonneault (2011) tested the reliability and validity of the instrument for measuring IT infrastructure flexibility. The results show that the reliability of the instrument is high, as reflected by the high factor reliability score in Bryd and Tuner's (2000) study and higher composite reliability scores (all higher than 0.85) for each of the dimensional constructs of IT infrastructure flexibility. The validity of the instrument is sound, as reflected by the high loading score of each measurement indicator on its corresponding construct in Tallon and Pinsonneault's (2011) study. We developed our scale for measuring IT infrastructure flexibility mainly based on Tallon and Pinsonneault's (2011) study.

In summary, IT infrastructure flexibility has been measured as a second-order variable in the literature. There are three dimensions in IT infrastructure flexibility. The three dimensions of IT infrastructure flexibility include connectivity, hardware compatibility, and software modularity.

5.2.3 Scale for Organizational Agility

Organizational agility refers to speed with which a firm can sense/detect market opportunities and threats and act/respond to those opportunities and threats by assembling and integrating internal and external resources, including assets, knowledge, and relationships (Hitt et al. 1998; Sambamurthy et al. 2003; Tallon and Pinsonneault (2011). Sambamurthy et al. (2003) first argued that there are three dimensions of organizational agility, namely, customer responsiveness agility, operational agility, and partnership agility. Tallon and Pinsonneault (2011) devised a set of eight indicators to assess the organizational agility in each of these three dimensions. Tallon and Pinsonneault (2011) tested their scale's reliability and validity. The reported composite reliability score for their agility construct is 0.862. This composite reliability score suggests that the scale for agility has the internal reliability. Their assessment also shows that the loading score of each measurement indicator on its corresponding factor (dimensions) exceeded the recommended threshold score of 0.5 (this cutoff value is very arbitrary), and each indicator has a higher loading score on its own construct than on the other constructs. These loading scores suggest that the scale has convergent and determinant validity. We developed our measurement scale for organizational agility based on Tallon and Pinsonneault's (2011) scale.

5.2.4 Scale for Environmental Turbulence

Environmental turbulence is defined as "general conditions of uncertainty" (Rai and Tang 2010, p. 521), with "unpredictability arising from unexpected changes in market demand and consumer preferences, new technology developments, and technological breakthroughs" (El Sawy and Pavlou 2008, p. 139). The general conditions of uncertainty may come from two aspects in modern business environment: market turbulence and technology turbulence. Market turbulence refers to "the rate of change in the composition of customers and their preferences," and technology turbulence refers to the rate of change in technology (Jaworski and Kohli 1993). Jaworski and Kohli (1993) developed a scale for measuring market turbulence and technology turbulence. The Crontach's α values of the constructs were reported by Jaworski and Kohli

(1993). The Crontach's α for market turbulence is 0.68, which is a little bit lower than the recommended threshold value of 0.7 (Nunnally and Berbstein 1994; Kline 2005). However, Robinson et al. (1991) also argued that a Crontach's α value of 0.6 is acceptable. Jaworski and Kohli (1993) did not report the validity assessments of the scale. The reliability and validity of the scale were assessed in Pavlou and El Sawy's (2006) study. Pavlou and El Sawy (2006) reported a score of 0.85 for the composite reliability, indicating a high internal reliability. Convergent and discriminant validity are inferred by the measurements that load much higher on their own construct than on other constructs. The validity is also confirmed by large average variance extracted (AVE) scores for the constructs. This study developed the measurement scale for environmental turbulence based on the studies of Jaworski and Kohli (1993) and Pavlou and El Sawy (2006).

5.2.5 Scale for Competitive Advantage

This study has extensively discussed the construct of competitive advantage in the literature review section. There are two model domains in competitive dynamics research that describe an organization's competitive advantage from a different level: industrial (environmental) and organizational (firm)-specific level. Competitive advantages at the organizational-specific level come from cost efficiency leadership and quality differentiation (Porter 1980; Teece et al. 1997). Competitive advantages at the industrial level come from an organization's ability to interact with the five market forces in its market environment (Porter 1980; Porter 1985).

The IS literature has produced several scales to measure competitive advantage. However, some of them are specific to certain advantages in a specific industry. For example, Pavlou and El Sawy (2006, 2010) developed a competitive advantage scale for new product development. Nidumolu and Knotts (1998) developed a scale for measuring general competitive advantage. Nidumolu and Knotts (1998) derived their scales for measuring two dimensions of competitive performance from manufacturing strategy research. One dimension is product cost efficiency, which describes the efficiency with which the organization produces its products; the other dimension is market responsiveness, which describes how timely the organization is in responding to market changes. This study argued in the literature review section that perceived competitive performance is inseparable from competitive advantage because competitive positioning (advantage) determines organizations' ultimate performance (Porter 1980). Therefore, the two dimensions of perceived competitive performance can well be the two dimensions of competitive advantage. These dimensions are well supported by the two domains of competitive advantage models. This study argues that although the two dimensions of competitive performance were derived from manufacturing strategy research, they are valid for other industries according to the two domains of models that describe competitive advantage.

Nidumolu and Knotts (1998) assessed the reliability and validity of their scale. The Cronbach α is 0.81 and 0.83 for cost efficiency and market responsiveness, respectively. The factor loadings of the indicators on their own constructs are high except those of two indicators (p. 136). This study developed the scale for measuring competitive advantage based on the measurement scale from Nidumolu and Knotts (1998). The reliability and validity of the developed scale were assessed again in this study.

5.3 Participants

The population of interest of this study is the business leaders whose companies are using business intelligence for various purposes.

A total of 18,000 senior business leaders were selected from U.S. companies that had at least 20 million dollars in annual revenue. These senior business leaders include CEOs, CFOs, CTOs, CIOs, VPs for business functions, and senior business directors or managers. We chose business leaders from each organization as our primary respondents because they are the operation managers who use BI and know the degree of their organizational agility and competitive advantage. The IT infrastructure–related questions are business-oriented so that an executive without technical knowledge can answer those IT infrastructure–related questions.

We received the participants' e-mail addresses, along with other information such as the contact's title in the company, the company name, and the company's annual revenue, through a commercial direct marketing company, ConsumerBase, LLC. ConsumerBase is one of the top e-mail mailing companies. It is ranked no. 1 for data card quality by NextMark, a multichannel target marketing company. A data card is an industry-wide standard for providing list buyers with information on a variety of mailing lists. All e-mails from ConsumerBase are 100% opt-in and 100% guaranteed deliverable within 30 days of purchase.

5.4 Data Collection

We used Qualtrics.com to host our survey. The authors' university has a site license from Qualtrics, which is a leading Web-based marketing research provider. With that license, we built a survey Web site that meets all of our research needs. It provides easy-to-use tools to build and manage a survey.

The initial invitation e-mails, with several rounds of reminding e-mails were sent out to the selected executives. The data collection period was one month. We sent out our email invitation on Tuesdays and Fridays at local noon time to improve the response rate.

5.5 Data Analysis Technique

There are two techniques to assess a regression structural model: one is the covariance-based SEM as represented by LISREL, and the other is the component-based (or variance-based) SEM, as represented by partial least square (PLS) modeling (Henseler et al. 2009).

Covariance-based SEM attempts to minimize the difference between the sample covariance and those predicted by the model using the maximum likelihood (ML) function (Chin and Newsted 1999); Overall model fit indices are provided for the estimation. Given that covariance-based SEM reproduces the covariance matrix of all indicator measures, it requires a very large sample size (Chin and Newsted 1999; Kline 2005). Kline (2005) suggests that a desired sample size would be 20 times free parameters. Because one of the assumptions for covariance-based SEM is that measurement indicators should be reflective in nature (Chin and Newsted 1999), covariance-based SEM typically works only with reflective indicators or structures.

The alternative technique in SEM is PLS modeling. PLS is a component or variance-based SEM technique. PLS modeling has been used by a growing number of researchers from various disciplines, including management information systems. Unlike covariance-based SEM technique, PLS explicitly creates constructs scores by weighting sums of measuring indicators underlying each latent variable. Then, regressions are carried out on the LV scores for estimating the structural equations (Chin 2010).

Chin et al. (2003) presented issues related to estimate moderating effects, using covariance-based SEM technique when the measurement scale of a moderator has continuous values and the product-indicator method is used to estimate moderating effects. This study examines the moderating effects of environmental turbulence on relationships between organizational agility and competitive advantage, BI use and organizational agility, IT infrastructure flexibility and organizational agility, and IT infrastructure flexibility and BI use. The measurement scale for the moderator has continuous values for each of the measurement indicator. This is one reason we chose PLS over the covariance-based SEM technique for this study. Even without analysis of the moderation effect using product indicator terms, a covariance-based SEM technique is not appropriate to handle a complex model, such as the one in this study. The sample size required for our model could reach 1000 (4 second-order constructs, 11 first-order constructs, and a total of 54 indicators) if a covariance-based SEM technique was used. Chin et al. (2003, p. 197) stated that "the model complexity increases beyond 40–50 indicators, the LISREL software may not even converge." It is another reason why we chose the variance-based SEM technique for analyzing the data in this study. This study uses SmartPLS, a PLS software developed by Ringle et al. (2005).

PLS was employed in this study to assess the measurement and structural models. PLS is appropriate for this study because it is variance based and places minimal restrictions on measurement scales, sample size, and residual distribution (Chin et al. 2003). PLS does not require multivariate normality (Birkinshaw et al. 1995; Henseler et al. 2010).

Chapter 6

Results, Findings, and Discussion

6.1 Demographic Information of Participants

6.1.1 Data Screening and Sample Size

A total of 237 completed entries were collected during the four-week data collection period. Twenty-one cases were eliminated from the sample because they were either incomplete responses or the organizations were not using any business intelligence system. One case had the cross-board value of 1 and another had 7. They were also removed from sample. The final sample size in this study is 214.

Barclay et al. (1995) and Chin (1998b) proposed a heuristic rule of thumb for the minimum sample size in PLS analysis. The heuristic rule of thumb is called the “10 times” rule. The “10 times” rule suggests that the minimum total number of cases needed for a PLS analysis should be 10 times either (1) the dependent constructs with the largest number of independent constructs (predictors) influencing it or (2) the block with the largest number of formative indicators, whichever is greater. In this study, there are no formative indicators for any construct. The largest number of independent constructs is 4. Therefore, the minimum number of cases for analyzing the model is 40.

The better way to predetermine the sample size of a study is doing power analysis. This study used G*Power, developed by Erdfelder et al. (1996), to find the sample size with 80% power for the analysis. The calculated minimum sample size from G*Power 3 for this study was 43, using the following criteria: one tail; effect size, 0.10 (small effect); 95% confidence level; power, 80%; and number of predictors, 4. The required sample size will increase to 70 if the confidence level is changed to 99%.

However, this study involves moderation effects. The moderation effects are analyzed using product-indicator interaction terms (Chin et al. 2003). The minimum number of cases for analyzing a moderation effect using the product-indicator method is the product of the number of indicators of the moderator variable and the predictor variable. The largest product in this study is 112; therefore, 112 is the minimum number of cases needed for estimating the moderating effects.

In summary, if we only analyzed the model without taking into account the moderation effects, the minimum sample size for this study is 43, with 80% power to detect the significant effects at the 95% confidence level. But with the consideration of the moderation effects, the minimum sample size increases to 112. We have a sample size of 214 that is more than the minimum number of cases needed to assess the whole model.

6.1.2 Demographics of the Participants

The population of interest for this study includes business executives from U.S. companies that have minimum annual revenue of 20 million dollars. Tables 6.1.1–6.1.7 display the demographic information of the participants in this study.

Table 6.1.1: Participants Age

Age	**Number of Subjects**	**Percentage**
Missing data	1	0.5%
Younger than 25	0	0%
Between 26 -- 35	1	0.5%
Between 36 -- 45	22	10.3%
Between 46 -- 55	110	51.4%
Between 56 -- 65	69	32.2%
Between 66 -- 75	10	4.7%
Older than 75	1	1.5%
Total	214	100%

Table 6.1.2: Total number of years in Management positions

Number of years in Management Positions	Number of Subjects	Percentage
Missing data	1	0.5%
Less than 1 year	0	0%
Between 1 – 5 years	0	0%
Between 6 – 10 years	14	6.5%
Between 11 – 15 years	27	12.6%
Between 16 – 20 years	45	21.0%
Between 21 – 25 years	43	20.1%
More than 25 years	84	39.3%
Total	214	100%

Table 6.1.3: Total number of years in current positions

Number of years in Management Positions	Number of Subjects	Percentage
Missing data	1	0.5%
Less than 1 year	3	1.4%
Between 1 – 5 years	92	43.0%
Between 6 – 10 years	55	25.7%
Between 11 – 15 years	30	14.0%
Between 16 – 20 years	23	10.7%
Between 21 – 25 years	8	3.7%
More than 25 years	2	0.9%
Total	214	100%

Table 6.1.4: Participants' job title in their companies

Title	Number of Subjects	Percentage
CEO	45	21.0%
COO	10	4.7%
CFO	13	6.1%
CIO	25	11.7%
PRESIDENT	15	7.0%
VP	67	31.3%
Other Senior Directors/Managers	39	18.2%
Total	214	100%

Table 6.1.5: Industry represented by participants

Industry	Number of Subjects	Percentage
Basic material (basic resources, chemicals)	5	2.3%
Consumer goods (auto & parts, food beverage, personal & household goods)	22	10.3%
Consumer services (media, retail, travel & leisure)	7	3.3%
Education (K-12 and higher education)	4	1.9%
Financials (banks, financial services, insurances)	31	14.5%
Government (federal and local governments)	7	3.3%
Health care	39	18.2%
Industrials (construction & materials, industrial goods & services)	22	10.3%
Oil & Gas	4	1.9%
Technology (software & computer services, technology hardware & equipment)	46	21.5%
Telecommunications	3	1.4%
Utilities	1	0.5%
Professional services	18	8.4%
Manufacturing	5	2.3%
Total	214	100%

Table 6.1.6: Number of employees of participants' companies

Number of employees	Number of Subjects	Percentage
Missing data	2	0.9%
1 – 49	26	12.1%
50 – 499	53	24.8%
500 or More	133	62.1%
Total	214	100%

Table 6.1.7: Annual revenue of participants' companies

Annual revenue	Number of Subjects	Percentage
Missing	11	5.1%
Less than 50 million dollars	38	17.8%
50 – 100 million dollars	27	12.6%
100 – 250 million dollars	23	10.7%
250 – 500 million dollars	18	8.4%
500 – 1 billion dollars	23	10.7%
1 – 2 billion dollars	15	7.0%
More than 2 billion dollars	59	27.6%
Total	214	100%

6.2 Descriptive and Response Statistics

6.2.1 Descriptive Statistics

The descriptive statistics for the survey indicators are listed in Tables 6.2.1–6.2.5.

Table 6.2.1: Descriptive Statistics for Business Intelligence Use

	N	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
							Std. Error		Std. Error
QB1	214	1	7	5.64	1.228	-1.249	.166	1.884	.331
QB2	214	2	7	5.79	1.103	-1.451	.166	2.630	.331
QB3	214	2	7	5.60	1.116	-1.015	.166	1.292	.331
QB4	213	2	7	5.36	1.276	-1.048	.167	.919	.332
QB5	214	2	7	5.41	1.248	-.863	.166	.483	.331
QB6	213	1	7	4.85	1.513	-.625	.167	-.224	.332
QB7	214	1	7	5.42	1.267	-.934	.166	.848	.331
QB8	213	2	7	5.77	1.101	-1.339	.167	2.399	.332
QB9	213	1	7	5.34	1.228	-.963	.167	1.141	.332
QB10	214	1	7	5.18	1.328	-.812	.166	.326	.331
QB11	214	1	7	5.38	1.246	-1.098	.166	1.137	.331
QB12	214	1	7	5.12	1.490	-.846	.166	.157	.331
QB13	214	2	7	5.38	1.238	-.918	.166	.594	.331
Valid N (listwise)	211								

Table 6.2.2: Descriptive Statistics for Organizational Agility

	N	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
							Std. Error		Std. Error
QO1	214	1	7	4.58	1.370	-.299	.166	-.401	.331
QO2	214	1	7	4.87	1.544	-.614	.166	-.354	.331
QO3	214	1	7	4.62	1.371	-.572	.166	-.293	.331
QO4	214	1	7	5.02	1.416	-.793	.166	.422	.331
QO5	213	1	7	4.37	1.517	-.377	.167	-.574	.332
QO6	214	1	7	4.27	1.495	-.243	.166	-.680	.331
QO7	214	1	7	4.27	1.526	-.202	.166	-.836	.331
QO8	213	1	7	4.68	1.573	-.415	.167	-.543	.332
Valid N (listwise)	213								

Table 6.2.3: Descriptive Statistics for Environmental Turbulence

	N	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
							Std. Error		Std. Error
QE1	214	1	7	5.25	1.482	-.879	.166	.134	.331
QE2	213	1	7	4.60	1.704	-.363	.167	-1.067	.332
QE3	214	1	7	5.46	1.531	-1.153	.166	.510	.331
QE4	213	2	7	5.69	1.212	-1.178	.167	1.151	.332
QE5	214	1	7	4.81	1.305	-.442	.166	-.051	.331
QE6	214	1	7	4.38	1.464	-.288	.166	-.783	.331
QE7	214	1	7	4.44	1.458	-.218	.166	-.724	.331
QE8	214	1	7	4.42	1.418	-.256	.166	-.662	.331
QE9	213	1	7	4.08	1.440	-.045	.167	-.956	.332
QE10	214	1	7	3.07	1.512	.876	.166	-.054	.331
QE11	214	1	7	5.18	1.484	-.692	.166	-.219	.331
QE12	213	2	7	5.55	1.301	-.972	.167	.614	.332
QE13	214	1	7	5.21	1.450	-.716	.166	-.152	.331
QE14	214	1	7	4.90	1.485	-.464	.166	-.399	.331
Valid N (listwise)	211								

Table 6.2.4: Descriptive Statistics for IT Infrastructure Flexibility

	N	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
							Std. Error		Std. Error
QI1	214	1	7	4.99	1.507	-.632	.166	-.429	.331
QI2	213	1	7	5.03	1.518	-.856	.167	.061	.332
QI3	214	1	7	5.01	1.583	-.940	.166	.055	.331
QI4	214	1	7	4.42	1.656	-.289	.166	-.914	.331
QI5	214	1	7	4.06	1.594	.006	.166	-.888	.331
QI6	213	1	7	3.87	1.558	.077	.167	-.862	.332
QI7	213	1	7	4.84	1.493	-.668	.167	-.407	.332
QI8	213	1	7	4.27	1.518	-.331	.167	-.530	.332
QI9	213	1	7	4.08	1.467	-.120	.167	-.760	.332
QI10	213	1	7	4.56	1.451	-.365	.167	-.562	.332
QI11	214	1	7	4.09	1.281	-.167	.166	-.413	.331
QI12	214	1	7	4.23	1.260	-.066	.166	-.492	.331
QI13	213	1	7	4.87	1.369	-.748	.167	.089	.332
QI14	214	1	7	5.00	1.339	-.817	.166	.323	.331
QI15	214	1	7	4.84	1.413	-.624	.166	-.267	.331
QI16	214	1	7	5.16	1.327	-.815	.166	.404	.331
QI17	214	1	7	5.21	1.316	-.884	.166	.643	.331
QI18	214	1	7	4.12	1.404	-.025	.166	-.853	.331
QI19	214	1	7	4.38	1.401	-.223	.166	-.377	.331
Valid N (listwise)	210								

Table 6.2.5: Descriptive Statistics for Competitive Advantage

	N	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
							Std. Error		Std. Error
QC1	214	1	7	4.41	1.421	-.230	.166	-.509	.331
QC2	214	1	7	5.04	1.131	-.692	.166	.794	.331
QC3	214	1	7	4.79	1.275	-.262	.166	-.093	.331
QC4	214	1	7	4.97	1.216	-.507	.166	.194	.331
QC5	214	1	7	5.04	1.285	-.392	.166	-.210	.331
QC6	214	1	7	4.57	1.176	-.185	.166	-.005	.331
QC7	214	1	7	4.56	1.316	-.258	.166	.066	.331
Valid N (listwise)	214								

6.2.2 Response Rate

Online survey response rate varies widely and is affected by many factors. It is hard to tell what the mean response rate for an online survey is. Trade report shows that the online survey response rate can range from lower than 2% to higher than 15% for an external survey. The response rate for the survey of this study is lower than 2%. It is at the low end of the reported response rate range. However, a key question related to a response rate is whether or not there is a nonresponse bias in the responses due to the low response rate. Nonresponse bias occurs if persons who respond differ substantially from those who do not (Armstrong and Overton 1997). A low response rate alone will not warrant nonresponse bias (Sax et al. 2003; Groves 2006). There is no empirical finding that supports the linkage between nonresponse rates and nonresponse biases (Groves 2006).

There are several approaches to estimate the possible nonresponse bias: (1) comparison with known values for the population; (2) subjective estimates; and (3) extrapolation. A critic to "comparison with known values for the population" is that because the "known" values of the measurement indicators from the population may come from a different source instrument, the differences may occur as a result of response bias rather than nonresponse bias (Wiseman 1972; Armstrong and Overton 1977).

Subjective estimates could be a practical method. One suggestion is to determine socioeconomic differences between respondents and nonrespondents (Kirchner and Mousley 1963). We have the information of the titles of respondents in our data. Following that suggestion, we compared the response rate from each title category (e.g., CEO, CIO, CTO, CFO, VP, or senior directors/managers) of the respondents with the response rate from each title category of the nonrespondents. We did not find a significant difference in response rate between any pair. This helps mitigate the concern of nonresponse bias.

Extrapolation methods are built on the assumption that subjects who respond later are more likely nonrespondents. We used a Chi-square test of key demographic variables for equal distributions of values in early and late responses. Those who responded before two weeks from the initial e-mail invitation are set as earlier respondents; those who responded after two weeks from the initial e-mail invitation are set as later respondents. Tables 6.2.6 – 6.2.10 present the actual counts of responses for different categories in early and late periods. The Chi-square results from SPSS are listed in Table 6.2.11.

Table 6.2.6 Subject title in early and late response periods

Title	Number of Responses		Total
	Early	Late	
CEO	19	26	45
CFO	5	8	13
CIO	14	11	25
COO	7	3	10
DIR	22	17	39
PRES	9	6	15
VP	43	24	67
Total	119	95	214

Table 6.2.7 Subject industry in early and late response periods

Industry	Number of Responses		Total
	Early	Late	
Basic material	3	2	5
Consumer goods	11	11	22
Consumer services	6	1	7
Education	3	1	4
Financials	16	15	31
Government	4	3	7
Health care	19	20	39
Industrials	10	12	22
Oil and Gas	3	1	4
Technology	27	19	46
Telecommunications	3	0	3
Utilities	1	0	1
Professional services	10	8	18
Manufacturing	3	2	5
Total	119	95	214

Table 6.2.8 Subject age in early and late response periods

Age Group	Number of Responses		Total
	Early	Late	
Between 26 -- 35	1	0	1
Between 36 -- 45	10	12	22
Between 46 -- 55	59	51	110
Between 56 -- 65	41	28	69
Between 66 -- 75	6	4	10
Older than 75	1	0	1
Total	118	95	213

Table 6.2.9 Yeas in management positions in early and late response periods

Years in management positions	Number of Responses		Total
	Early	Late	
6 -- 10 years	6	8	14
11 -- 15 years	12	15	27
16 -- 20 years	22	23	45
21 -- 25 years	25	18	43
more than 25 years	53	31	84
Total	118	95	213

Table 6.2.10 Company size in terms of employee number in early and late response periods

Company size	Number of Responses		Total
	Early	Late	
1 -- 49	11	15	26
50 -- 499	32	21	53
500 or more	74	59	133
Total	117	95	212

The Chi-square test shows equal distribution between early and late respondents for equal distribution of age, industry, title, year in a management position, and company size. Based on the assumption for extrapolation and nonsignificant results for those key demographic variables, we can assume that the nonresponse bias in the data is kept at an acceptable level and the sample of this study sufficiently represents the population of interest.

Table 6.2.11: Chi-square Test for Equal Distribution

Demographic Variable	p-value for Early vs. Late Respondent
Age	>0.67
Industry	>0.74
Title	>0.25
Year in Management Positions	>0.27
Company Size (by employee number)	>0.31

6.2.3 Common Method Bias

Common method bias is a potential problem in research, especially in survey research (Campbell and Fiske 1959; Podsakoff et al. 2003). Several post hoc statistical analyses can help determine if there is an excessive common method variance in data.

Harman's single-factor test is one of the most widely used post hoc method to determine if there is a common method variance in data (Podsakoff et al. 2003). Podsakoff et al. (2003, p. 889) suggested that if a substantial amount of common method variance is present, then "either (a) a single factor will emerge from the factor analysis or (b) one general factor will account for the majority of the covariance among the measures." We performed the principal components factor analysis using SPSS. Eleven factors emerged from the analysis. There is no single factor that has excessive variance. This test suggests that no excessive common method bias exists in the data.

The partial correlation method is another method to check common method bias in data (Podsakoff et al. 2003). Following Pavlou and El Sawy's (2006) procedure for this method, we added the highest factor from the principal component analysis to the PLS model as the control variable on dependent variables. This factor did not produce a significant change in explained variance in the dependent variables in the model.

Correlation analysis can also help determine if there is an excessive common method variance in data (Bagozzi et al. 1991). Table 6.2.7 presents the correlation matrix of the second-order constructs in this study. Bagozzi et al. (1991) suggested that a correlation > 0.9 would indicate evidence of common method bias. The highest correlation among the first order of constructs is 0.62 between organizational agility and competitive advantage. This analysis also suggests no excessive common method bias in the data.

Table 6.2.7 Correlations among the Second Order Constructs

	BI Use	Competitive Advantage	Environmental Turbulence	IT Infrastructure Flexibility	Organizational Agility
BI Use	1	0	0	0	0
Competitive Advantage	0.28	1	0	0	0
Environmental Turbulence	0.11	0.17	1	0	0
IT Infrastructure Flexibility	0.33	0.37	0.30	1	0
Organizational Agility	0.25	0.62	0.32	0.44	1

These statistical tests suggest there is no excessive common method variance in our data.

6.3 Measurement Reliability and Validity

Measurement should be subjected to reliability and validity test before the research model assessment. Measurement reliability assesses if a measurement instrument is free from random error and is consistent, stable, and dependable. A reliable measurement scale does not imply a valid measurement scale. Measurement validity assesses whether a measurement instrument measures what it is supposed to measure (Rosnow and Rosenthal 1998). Typically two kinds of measurement validity are assessed in a research: discriminant and convergent validity. We report in this section the assessment of measurement reliability and validity of the scales used in this study.

Table 6.3.1 shows the short names used in the tables in section 6.3:

6.3.1: Short names for the first and second order constructs

Short Name	**Construct**
BI Use	business intelligence use
Comp Adv+	Competitive Advantage
Cost Adv	Cost Advantage
Mark Adv	Market Advantage
Env Turb+	Environmental Turbulence
Mark Turb	Market Turbulence
Tech Turb	Technology Turbulence
IT Flex+	IT Infrastructure Flexibility
IT Conn	IT Connectivity
IT Hard	IT Hardware/Software Compatibility
IT Mod	IT Modularity
Org Agil+	Organizational Agility
Cust Agil	Customer Agility
Oper Agil	Operation Agility
Part Agil	Partner Agility

+ → Second order construct

6.3.1 Measurement Reliability

The internal consistency reliability of a measurement scale is typically assessed using two statistics: one is the Cronbach's α, and the other is the composite reliability indicator. All SEM software provides statistics for testing measurement consistency. SmartPLS (Ringle et al. 2005) was used to calculate these two statistics for all the constructs.

Table 6.3.2 displays the Cronbach's α and composite reliability. These values are calculated after we dropped some indicators that have convergent and discriminant validity issues for their corresponding constructs.

The suggested acceptable value of the Cronbach's α for a reliable construct is 0.7 (Nunnally and Berbstein 1994; Kline 2005). The Cronbach's α values for all first- and second-order constructs, except for partner agility, were higher than the suggested acceptable value.

These Cronbach's α values show high reliability of all the measurement scales, except the scale for partner agility. The Cronbach's α is calculated with the assumption that all measured indicators are equally weighted. Failure to meet this assumption results in underestimated reliability (Bollen 1989; Chin 1998a). To relax the assumption for calculating the Cronbach's α, an alternative score, that is, composite reliability, was developed, which is considered a more accurate measurement of reliability than the Cronabch's α (Fornell and Larcker 1981; Chin 1998a; Chin 2010). The acceptable value for composite reliability is 0.70 or higher (Nunnally and Berbstein 1994). All the constructs in the model of this study have a composite reliability value above the threshold value.

Table 6.3.2 Construct Reliability Result –Cronbach's Alpha and Composite Reliability

Construct	**Indicators**	**Cronbach's α**	**Composite Reliability**
BI Use	QB1, QB2, QB3, QB4, QB5, QB6, QB7, QB8, QB9, QB10, QB11, QB12, QB13	0.93	0.94
IT Flex$^+$	QI1, QI2, QI3, QI4, QI5, QI6, QI7, QI8, QI9, QI10, QI12, QI13, QI14, QI15, QI16,QI17 QI18, QI19	0.92	0.93
IT Conn	QI1, QI2, QI3, QI4	0.80	0.87
IT Hard	QI5, QI6, QI7, QI8, QI9	0.80	0.87
IT Mod	QI10, QI12, QI13, QI14, QI15, QI16,QI17 QI18, QI19	0.92	0.94
Org Agil$^+$	QO1, QO2, QO3, QO4, QO5, QO6, QO7, QO8	0.86	0.89
Cust Agil	QO1, QO2, QO3	0.75	0.85
Oper Agil	QO4, QO5, QO6	0.72	0.84
Part Agil	QO7, QO8	0.61	0.83
Comp Adv$^+$	QC1, QC2, QC3, QC4, QC5, QC6, QC7	0.85	0.89
Cost Adv	QC1, QC2, QC3	0.74	0.85
Mark Adv	QC4, QC5, QC6, QC7	0.86	0.91
Env Turb$^+$	QE2, QE6, QE7, QE9, QE11, QE12, QE13, QE14	0.86	0.89
Mark Turb	QE2, QE6, QE7, QE9,	0.75	0.84
Tech Turb	QE11, QE12, QE13, QE14	0.90	0.93

The Cronbach's α and composite reliability values of the constructs in the model of this study suggest that the measurement instruments of this study are reliable.

6.3.2 Measurement Validity

Scholars have emphasized that two elements of construct validity must be examined in PLS assessments (Gefen and Straub 2005). Those two elements of construct validity are discriminant and convergent validity. Convergent validity is assumed when each measurement indicator correlates highly with its own construct; discriminant validity is assumed when each measurement indicator correlates not highly with all other constructs (Gefen and Straub 2005).

There is no established threshold loading value to determine the convergent and discriminant validity. Hair et al. (1998) has suggested a rule of thumb of a factor loading value of 0.6 or higher as the highly loading coefficient value and 0.4 or lower as the not highly loading coefficient value, which is accepted by other scholars (Gefen and Straub 2005). Gefen and Straub (2005) also suggest another criterion to determine convergent and discriminant validity for confirmatory factor analysis: all the loadings of the measurement indicators on their assigned latent construct should be an order of magnitude larger than any other loading (p. 93). This study uses the value 0.6 as the threshold value between highly and not highly loading values and one order of magnitude difference as a large difference.

If a specific construct is more correlated with another construct than with its own measures, it is possible that the two constructs share the same types of measures; therefore, the construct is not conceptually distinct, and a discriminant validity problem may occur (Chin 2010). Gefen and Straub (2005) and Chin (2010) suggest the two steps to determine the discriminant and convergent validity of a construct: (1) all the measurement indicators of a construct load highly on their theoretically assigned construct and not highly on other construct; and (2) the square root of the construct's AVE is much larger than any correlation with any pair of latent constructs. If all indicators load on their own construct much better than on other constructs, it shows that the construct has convergent validity.

Tables 6.3.3a presents the factor loading values of indicators for all the first-order constructs. The original measurement indicators for BI use are QB1 to QB13; the original measurement indicators for Cost Adv are QC1 through QC3; the original measurement indicators for Mark Adv are QC4 to QC7; the original measurement indicators for Mark Turb are QE1, QE2, QE3, QE4, QE5, QE6, QE7, QE8, and QE9; the original measurement indicators for Tech Turb are QE11 through QE14.

From Table 6.3.3a, we see all corresponding measurement indicators of BI use, cost advantage, market advantage, and technology turbulence highly load on the respective constructs. However, the indicators QE1, QE3, QE5, QE8, QE9, and QE10 do not load highly on the construct market turbulence, so we will only keep QE2, QE4, QE6, and QE7 for the market turbulence construct. We also see QI9, QI18, and QI19 highly load on two constructs, which indicates there is a determinant issue for these indicators. We drop QI9, QI18, and QI19 from the indicator list. QI11 and QI12 do not load highly on their theoretical construct, so they are dropped from this study. All the other indicators highly load on their theoretical constructs.

Table 6.3.3b shows the factor loading values of indicators that are used in the final analyses.

Table 6.3.3a: Results of Confirmatory Factor Analysis – Factor Loadings

	BI Use	Cost Adv	Mark Adv	Mark Turb	Tech Turb	IT Conn	IT Hard	IT Mod	Cust Agil	Oper Agil	Part Agil
QB1	**0.67**	0.08	0.14	0.06	0.08	0.15	0.16	0.13	0.12	0.08	0.05

QB2	**0.67**	0.07	0.13	0.07	0.02	0.20	0.17	0.17	0.11	0.02	0.04
QB3	**0.76**	0.15	0.10	-0.01	0.05	0.16	0.19	0.21	0.21	0.10	0.16
QB4	**0.74**	0.09	0.17	0.00	0.12	0.17	0.14	0.17	0.19	0.09	0.10
QB5	**0.80**	0.17	0.18	0.00	0.09	0.21	0.20	0.28	0.14	0.14	0.15
QB6	**0.72**	0.12	0.21	0.02	0.14	0.19	0.18	0.30	0.22	0.18	0.24
QB7	**0.83**	0.26	0.28	0.04	0.13	0.26	0.22	0.26	0.27	0.20	0.19
QB8	**0.74**	0.15	0.17	-0.04	0.03	0.21	0.15	0.18	0.14	0.04	0.05
QB9	**0.82**	0.24	0.28	0.04	0.10	0.28	0.29	0.33	0.28	0.25	0.26
QB10	**0.72**	0.18	0.17	0.01	0.02	0.19	0.18	0.18	0.10	0.10	0.11
QB11	**0.72**	0.20	0.14	-0.03	-0.02	0.17	0.16	0.25	0.11	0.19	0.13
QB12	**0.73**	0.17	0.18	0.08	0.21	0.15	0.14	0.24	0.18	0.24	0.23
QB13	**0.80**	0.19	0.33	0.06	0.16	0.22	0.19	0.27	0.24	0.15	0.13
QC1	0.13	**0.84**	0.35	0.11	0.12	0.21	0.22	0.24	0.17	0.30	0.27
QC2	0.22	**0.75**	0.35	0.08	0.00	0.31	0.16	0.21	0.31	0.29	0.26
QC3	0.20	**0.84**	0.57	0.04	0.09	0.34	0.24	0.28	0.38	0.33	0.32
QC4	0.24	0.59	**0.89**	0.05	0.13	0.36	0.28	0.30	0.54	0.49	0.42
QC5	0.17	0.41	**0.81**	0.02	0.16	0.31	0.21	0.26	0.53	0.40	0.38
QC6	0.26	0.42	**0.89**	0.13	0.19	0.28	0.29	0.31	0.56	0.53	0.40
QC7	0.23	0.37	**0.77**	0.08	0.18	0.26	0.24	0.30	0.45	0.39	0.30
QE1	-0.02	0.09	0.01	0.58	0.36	0.08	0.16	0.09	0.07	0.09	0.16
QE2	0.02	0.07	0.14	**0.71**	0.42	0.04	0.13	0.18	0.27	0.20	0.29
QE3	0.03	-0.02	0.00	0.56	0.24	0.13	0.17	0.09	0.06	0.12	0.04
QE4	0.07	0.07	0.11	**0.76**	0.50	0.14	0.24	0.22	0.13	0.11	0.18
QE5	-0.09	-0.04	-0.14	0.55	0.31	-0.04	0.11	0.11	-0.04	-0.03	0.11
QE6	0.02	-0.01	-0.05	**0.68**	0.27	0.05	0.15	0.07	0.11	0.23	0.27
QE7	0.07	0.13	0.11	**0.66**	0.31	0.13	0.16	0.17	0.27	0.23	0.34
QE8	0.12	0.20	0.23	0.42	0.24	0.24	0.24	0.24	0.26	0.28	0.28
QE9	0.04	0.07	0.03	0.55	0.23	-0.01	0.09	0.03	0.08	0.12	0.22
QE10	-0.09	-0.02	0.06	0.35	0.14	0.01	0.11	-0.01	0.05	0.07	0.12
QE11	0.10	0.08	0.11	0.56	**0.89**	0.08	0.18	0.26	0.15	0.10	0.31
QE12	0.14	0.04	0.16	0.43	**0.85**	0.15	0.21	0.32	0.13	0.17	0.24
QE13	0.13	0.10	0.21	0.43	**0.90**	0.12	0.19	0.31	0.16	0.17	0.31
QE14	0.06	0.11	0.21	0.44	**0.87**	0.18	0.24	0.30	0.18	0.16	0.35
QI1	0.33	0.32	0.31	0.11	0.15	**0.83**	0.56	0.66	0.37	0.29	0.29
QI2	0.21	0.35	0.26	0.08	0.11	**0.84**	0.55	0.56	0.27	0.16	0.20
QI3	0.16	0.24	0.28	0.13	0.15	**0.77**	0.56	0.47	0.35	0.26	0.22
QI4	0.12	0.21	0.29	0.09	0.04	**0.73**	0.62	0.46	0.37	0.34	0.32
QI5	0.22	0.29	0.29	0.21	0.24	0.66	**0.87**	0.60	0.40	0.37	0.40
QI6	0.21	0.27	0.29	0.21	0.17	0.67	**0.87**	0.59	0.35	0.36	0.34
QI7	0.16	0.12	0.21	0.21	0.18	0.45	**0.72**	0.47	0.22	0.16	0.16

QI8	0.20	0.11	0.17	0.20	0.16	0.48	**0.71**	0.46	0.23	0.18	0.22
QI9	0.20	0.18	0.27	0.16	0.17	0.63	0.74	0.73	0.33	0.26	0.33
QI10	0.27	0.25	0.29	0.27	0.23	0.47	0.48	**0.67**	0.35	0.36	0.34
QI11	0.02	0.05	0.14	0.19	0.14	0.03	0.04	0.17	0.05	0.11	0.16
QI12	0.21	0.33	0.25	0.18	0.21	0.39	0.42	0.54	0.24	0.20	0.28
QI13	0.31	0.17	0.20	0.15	0.25	0.50	0.49	**0.81**	0.25	0.20	0.16
QI14	0.29	0.19	0.22	0.12	0.25	0.51	0.45	**0.85**	0.28	0.22	0.20
QI15	0.30	0.25	0.26	0.14	0.28	0.56	0.51	**0.86**	0.31	0.26	0.29
QI16	0.19	0.09	0.07	0.10	0.35	0.40	0.33	**0.76**	0.10	0.11	0.17
QI17	0.24	0.10	0.10	0.07	0.34	0.42	0.33	**0.77**	0.14	0.15	0.20
QI18	0.12	0.36	0.40	0.15	0.16	0.51	0.51	0.60	0.47	0.49	0.48
QI19	0.20	0.31	0.43	0.20	0.22	0.53	0.58	0.62	0.40	0.37	0.43
QO1	0.22	0.34	0.44	0.18	0.18	0.39	0.40	0.40	**0.80**	0.53	0.44
QO2	0.13	0.20	0.43	0.18	0.09	0.34	0.27	0.24	**0.78**	0.48	0.46
QO3	0.26	0.34	0.63	0.18	0.16	0.33	0.28	0.33	**0.87**	0.65	0.55
QO4	0.12	0.32	0.35	0.12	0.03	0.25	0.23	0.31	0.49	**0.71**	0.40
QO5	0.22	0.29	0.45	0.18	0.20	0.27	0.28	0.25	0.58	**0.81**	0.51
QO6	0.14	0.31	0.48	0.25	0.16	0.27	0.32	0.30	0.57	**0.88**	0.64
QO7	0.22	0.31	0.47	0.29	0.38	0.31	0.34	0.39	0.59	0.60	**0.88**

Table 6.3.3b: Results of Confirmatory Factor Analysis – Factor Loadings for Final Indicators

	BI Use	Cost Adv	Mark Adv	Mar kTurb	Tech Turb	IT Conn	IT Hard	IT Mod	Cust Agil	Oper Agil	Part Agil
QB1	**0.67**	0.08	0.14	0.12	0.08	0.15	0.16	0.17	0.12	0.08	0.05
QB2	**0.67**	0.07	0.13	0.10	0.02	0.20	0.17	0.18	0.11	0.02	0.04
QB3	**0.76**	0.15	0.10	0.03	0.05	0.16	0.19	0.23	0.21	0.10	0.16
QB4	**0.74**	0.09	0.17	0.04	0.12	0.17	0.14	0.20	0.19	0.09	0.10
QB5	**0.79**	0.17	0.18	0.01	0.09	0.21	0.20	0.28	0.14	0.14	0.15
QB6	**0.72**	0.12	0.21	-0.01	0.14	0.19	0.18	0.28	0.22	0.18	0.24
QB7	**0.83**	0.26	0.28	0.05	0.13	0.26	0.22	0.23	0.27	0.20	0.19
QB8	**0.74**	0.15	0.17	0.02	0.03	0.21	0.15	0.20	0.14	0.04	0.05
QB9	**0.82**	0.24	0.28	0.07	0.10	0.28	0.29	0.32	0.28	0.25	0.26
QB10	**0.72**	0.18	0.17	0.04	0.02	0.19	0.18	0.15	0.10	0.10	0.11
QB11	**0.72**	0.20	0.14	0.00	-0.02	0.17	0.16	0.26	0.11	0.19	0.13
QB12	**0.73**	0.17	0.18	0.06	0.21	0.15	0.14	0.25	0.18	0.24	0.23
QB13	**0.80**	0.19	0.33	0.07	0.16	0.22	0.19	0.25	0.24	0.15	0.13
QC1	0.13	**0.84**	0.35	0.08	0.12	0.21	0.22	0.15	0.17	0.30	0.27
QC2	0.22	**0.75**	0.35	0.11	0.00	0.31	0.16	0.16	0.31	0.29	0.26
QC3	0.20	**0.84**	0.57	0.04	0.09	0.34	0.24	0.19	0.38	0.33	0.32

QC4	0.24	0.59	**0.89**	0.07	0.13	0.36	0.28	0.18	0.54	0.49	0.42
QC5	0.17	0.41	**0.81**	0.02	0.16	0.31	0.21	0.17	0.53	0.40	0.38
QC6	0.26	0.42	**0.89**	0.16	0.20	0.28	0.29	0.19	0.56	0.53	0.40
QC7	0.23	0.37	**0.77**	0.11	0.18	0.26	0.24	0.24	0.45	0.39	0.30
QE2	0.02	0.07	0.14	**0.80**	0.42	0.04	0.13	0.18	0.27	0.20	0.29
QE4	0.07	0.07	0.11	**0.73**	0.50	0.14	0.24	0.21	0.13	0.11	0.18
QE6	0.02	-0.01	-0.05	**0.76**	0.27	0.05	0.15	0.03	0.11	0.23	0.27
QE7	0.07	0.13	0.11	**0.75**	0.31	0.13	0.16	0.11	0.27	0.23	0.34
QE11	0.10	0.08	0.11	0.54	**0.89**	0.08	0.18	0.26	0.15	0.10	0.31
QE12	0.14	0.04	0.16	0.41	**0.85**	0.15	0.21	0.30	0.13	0.17	0.24
QE13	0.13	0.10	0.21	0.41	**0.90**	0.12	0.19	0.32	0.16	0.17	0.31
QE14	0.06	0.11	0.21	0.40	**0.87**	0.18	0.24	0.30	0.18	0.16	0.35
QI1	0.33	0.32	0.31	0.09	0.15	**0.83**	0.56	0.58	0.37	0.29	0.29
QI2	0.21	0.35	0.26	0.07	0.11	**0.84**	0.55	0.47	0.27	0.16	0.20
QI3	0.16	0.24	0.28	0.14	0.15	**0.77**	0.56	0.37	0.35	0.26	0.22
QI4	0.12	0.21	0.29	0.10	0.04	**0.73**	0.62	0.36	0.37	0.34	0.32
QI5	0.22	0.29	0.29	0.15	0.24	0.66	**0.87**	0.46	0.40	0.37	0.40
QI6	0.21	0.27	0.29	0.19	0.17	0.67	**0.86**	0.42	0.35	0.36	0.34
QI7	0.17	0.12	0.21	0.20	0.18	0.45	**0.72**	0.36	0.22	0.16	0.16
QI8	0.20	0.11	0.17	0.18	0.16	0.48	**0.72**	0.39	0.23	0.18	0.22
QI10	0.26	0.25	0.29	0.24	0.23	0.47	0.48	**0.62**	0.35	0.36	0.34
QI13	0.31	0.17	0.20	0.16	0.25	0.50	0.49	**0.88**	0.25	0.20	0.16
QI14	0.29	0.19	0.22	0.13	0.25	0.51	0.45	**0.92**	0.28	0.22	0.20
QI15	0.30	0.25	0.26	0.17	0.28	0.56	0.51	**0.90**	0.31	0.26	0.29
QI16	0.19	0.09	0.07	0.12	0.35	0.41	0.33	**0.85**	0.10	0.11	0.17
QI17	0.24	0.10	0.10	0.12	0.34	0.42	0.33	**0.86**	0.14	0.15	0.20
QO1	0.22	0.34	0.44	0.20	0.18	0.39	0.40	0.32	**0.80**	0.53	0.44
QO2	0.13	0.20	0.43	0.22	0.09	0.34	0.27	0.12	**0.78**	0.48	0.46
QO3	0.26	0.34	0.63	0.21	0.16	0.32	0.28	0.25	**0.87**	0.65	0.55
QO4	0.12	0.32	0.35	0.12	0.03	0.25	0.23	0.22	0.49	**0.71**	0.40
QO5	0.22	0.29	0.45	0.21	0.20	0.27	0.28	0.18	0.58	**0.81**	0.51
QO6	0.14	0.31	0.48	0.25	0.16	0.27	0.32	0.22	0.57	**0.88**	0.64
QO7	0.21	0.31	0.47	0.31	0.38	0.31	0.34	0.28	0.59	0.60	**0.88**
QO8	0.13	0.29	0.26	0.28	0.19	0.23	0.27	0.16	0.40	0.50	**0.81**

After dropping the questionable indicators, we see from Table 6.3.3b that all the indicators highly load on their respective constructs and not highly load on other constructs.

Table 6.3.4 presents the factor loading values of first-order constructs on their corresponding second-order constructs. The loading values are all high and significant.

Table 6.3.4: Results of Factor Loadings of first-order constructs

	IT Flex	Org Agil	Comp Adv	Env Turb
IT Conn	**0.86**			
IT Hard	**0.83**			
IT Mod	**0.83**			
Cust Agil		**0.89**		
Oper Agil		**0.91**		
Part Agil		**0.82**		
Cost Adv			**0.81**	
Mark Adv			**0.93**	
Mark Turb				**0.81**
Tech Turb				**0.91**

Table 6.3.5 presents the AVE values and construct correlations for all the first-order constructs in the proposed model after we dropped the indicators that caused discriminant and convergent validity issues for their theoretical constructs.

Table 6.3.5 Constructs' Average Variance Extracted (AVE) and Correlation

AVE	SQRT of AVE	Construct Correlation											
			BI Use	Cost Adv	Mark Adv	Mark Turb	Tech Turb	Cust Agil	Oper Agil	Part Agil	IT Conn	IT Hard	IT Mod
0.56	0.75	BI Use	1.00										
0.66	0.81	Cost Adv	0.22	1.00									
0.71	0.84	Mark Adv	0.27	0.54	1.00								
0.58	0.76	Mark Turb	0.06	0.09	0.11	1.00							
0.77	0.88	Tech Turb	0.12	0.09	0.20	0.50	1.00						
0.67	0.82	Cust Agil	0.25	0.36	0.62	0.26	0.18	1.00					
0.64	0.80	Oper Agil	0.20	0.38	0.54	0.25	0.17	0.68	1.00				
0.72	0.85	Part Agil	0.21	0.35	0.44	0.35	0.35	0.59	0.65	1.00			
0.63	0.79	IT Conn	0.27	0.36	0.36	0.12	0.15	0.43	0.33	0.33	1.00		
0.63	0.79	IT Hard	0.25	0.26	0.31	0.23	0.23	0.39	0.35	0.36	0.72	1.00	
0.71	0.84	IT Mod	0.32	0.21	0.23	0.18	0.33	0.29	0.25	0.27	0.57	0.52	1.00

From Table 6.3.5, we see that the square roots of all the constructs' AVE are much larger than any correlation among any pair of latent constructs.

From the results of the analysis, we can assume that the modified measurement scale for all first-order constructs in this study have discriminant and convergent validity. Therefore, we can continue with our model assessments.

6.4 Model Assessment

6.4.1 Model Test Results

The full structural model was assessed using SmartPLS (Ringle et al. 2005). The resulting path coefficients are displayed in Figure 6.4.1. The significance of the path coefficients are tested with 300 bootstrap runs. All the path coefficients are significant. Tables 6.4.1 to 6.4.3 summarized the test results of the hypotheses.

Table 6.4.1: Hypothesis tests for the direct impacts

Hypothesis	**Independent Variable**	**Dependent Variable**	**Path Coefficient**	**Hypothesis Supported?**
H1	Organizational Agility	Competitive Advantage	0.60**	Yes
H2	BI Use	Organizational Agility	0.11*	Yes
H3	IT Infrastructure Flexibility	Organizational Agility	0.31**	Yes
H4	IT Infrastructure Flexibility	BI Use	0.32**	Yes

*Significant at $p < .05$
**Significant at $p < .01$

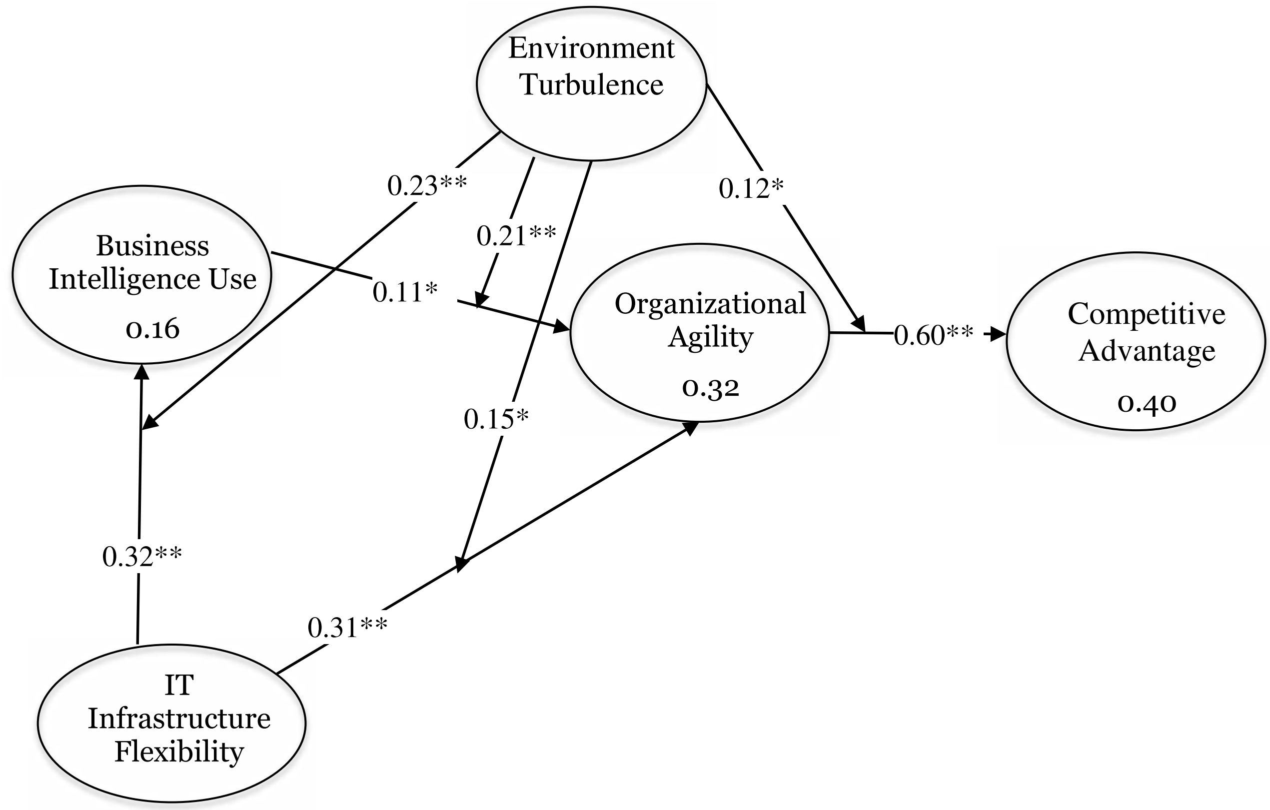

Figure 6.4.1: Test Results of The Full Structural Model

Notes: Number in a construct is the variance explained by its predictor(s)
*Significant at $p < 0.05$
**Significant at $p < 0.01$

6.4.2 Moderating Effects of Environmental Turbulence

The moderating effects are assessed using the product-indicator approach (Chin et al. 2003). The product-indicator approach creates for each interaction an interaction term by cross-multiplying all standardized indicators of involved constructs (the predictor and moderator constructs).

From Figure 6.4.1, we can see that environmental turbulence significantly moderate the effects between business intelligence use and organizational agility, IT infrastructure flexibility and organizational agility, IT infrastructure flexibility and business intelligences use, and organizational agility and competitive advantage. According to Chin et al. (2003), the moderating results from Figure 6.4.1 show the following:

1. One standard deviation increase in environmental turbulence will increase the impact of business intelligence use on organizational agility from 0.11 to 0.32 (0.11 + 0.21).
2. One standard deviation increase in environmental turbulence will increase the impact of IT infrastructure flexibility on organizational agility from 0.31 to 0.46 (0.31 + 0.15).
3. One standard deviation increase in environmental turbulence will increase the impact of IT infrastructure flexibility on business intelligence use from 0.32 to 0.55 (0.32 + 0.23).
4. One standard deviation increase in environmental turbulence will increase the impact of organizational agility on competitive advantage from 0.60 to 0.72 (0.60 + 0.12).

Table 6.4.2: Hypothesis tests for the moderating effects

Hypothesis	**Independent Variable**	**Dependent Variable**	**Moderator**	**Path Coefficient**	**Hypothesis Supported?**
H5	BI Use	Organizational Agility	Environmental Turbulence	0.21**	Yes
H6	IT Infrastructure Flexibility	Organizational Agility	Environmental Turbulence	0.15*	Yes
H7	Organizational Agility	Competitive Advantage	Environmental Turbulence	0.12*	Yes
H8	IT Infrastructure Flexibility	BI Use	Environmental Turbulence	0.23**	Yes

*Significant at $p < .05$
**Significant at $p < .01$

These results show the significant moderating effects of environmental turbulence on various relationships in the research model and support our moderating hypotheses. The testing results for those hypotheses are summarized in Table 6.4.2.

6.4.3 Mediating Role of Organizational Agility

We proposed that from the organizational agility perspective, business intelligence use, and IT infrastructure flexibility can serve as two contributing components to organizational agility, therefore indirectly contributing to an organization's competitive advantage, which is an important strategic value. This proposition implies that organizational agility mediates the impacts of business intelligence use and IT infrastructure flexibility on competitive advantage. We tested the mediating effects using two models for each mediating effect. We also tested the mediating effects of organizational agility when business intelligence use and IT infrastructure flexibility are together as predictors. Figure 6.4.2 shows the two models for testing the mediating effect of organizational agility on the relationship between IT infrastructure flexibility and competitive advantage. Figure 6.4.3 shows the two models for testing the mediating effect of organizational agility on the relationship between business intelligence use and competitive advantage.

The Model A in Figure 6.4.2 suggests that IT infrastructure flexibility has a significant direct effect on competitive advantage. However, Model B suggests that the impact of IT infrastructure flexibility on competitive advantage has lowered or become insignificant at the 0.01 significant level after organizational agility is included in the model. The testing results from these two models suggest that organizational agility at least partially mediates the effect of IT infrastructure flexibility on competitive advantage. If we set the significant level at $p < 0.01$ for the tests, then organizational agility fully mediates the effect of IT infrastructure flexibility on competitive advantage.

The model test results shown in Figure 6.4.3 suggest the same pattern of the mediating effect of organizational agility on the relationship between business intelligence use and competitive advantage.

We also tested the mediating role of organizational agility when business intelligence use and IT infrastructure flexibility are treated as predictors together. The model test results shown in Figure 6.4.4 suggest the same pattern of the mediating effect of organizational agility on the relationships when business intelligence use and IT infrastructure flexibility are treated as predictors together compared to when business intelligence use and IT infrastructure flexibility are treated as a predictor separately.

The testing results for mediating hypotheses in this study are summarized in Table 6.4.3.

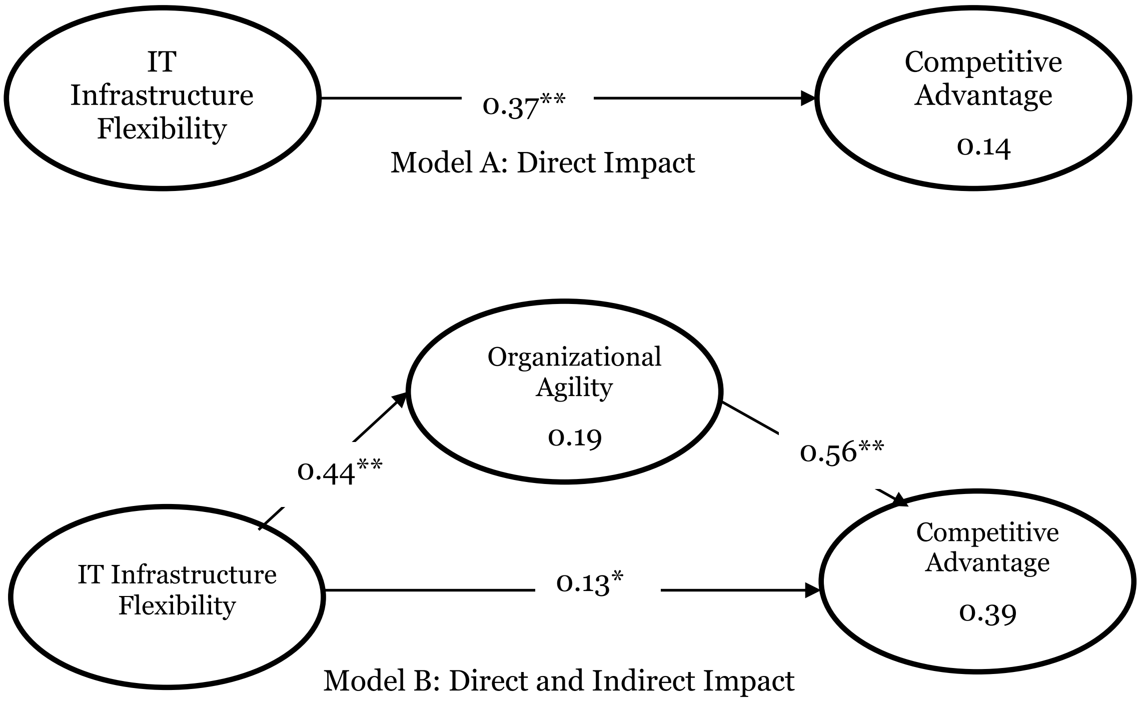

Figure 6.4.2: Mediating role of organizational agility on IT infrastructure flexibility and competitive advantage

** Significant at $p < 0.01$
*Significant at $p < 0.05$

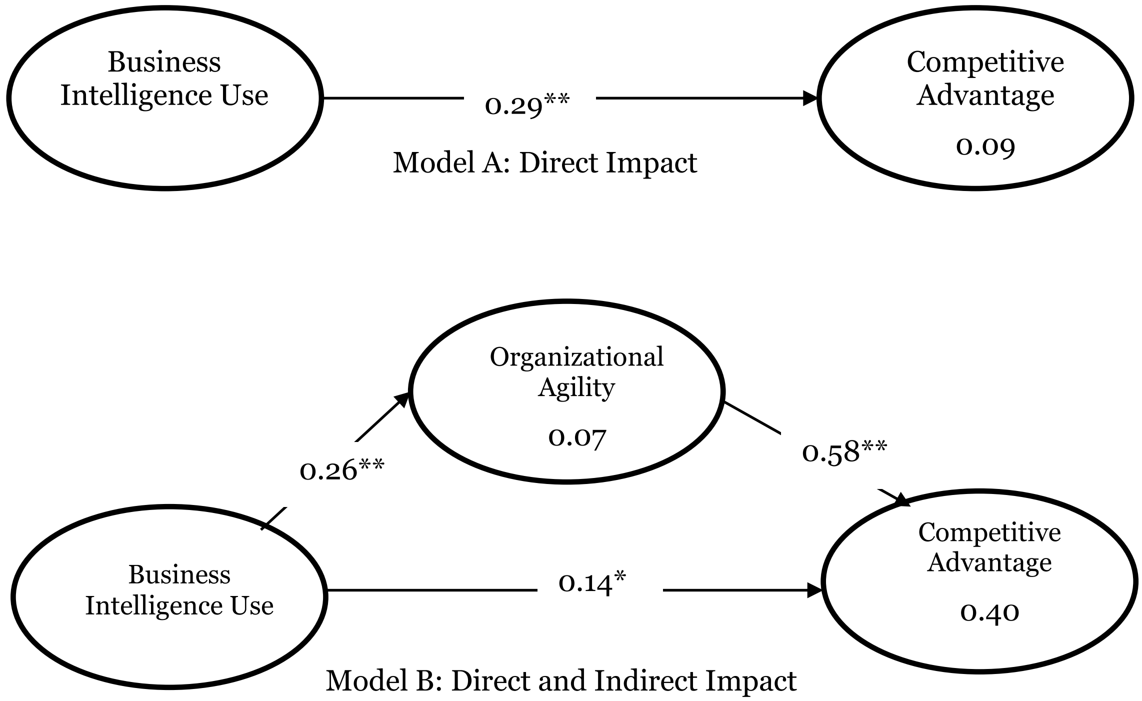

Figure 6.4.3: Mediating role of organizational agility on business Intelligence use and competitive advantage

** Significant at $p < 0.01$
*Significant at $p < 0.05$

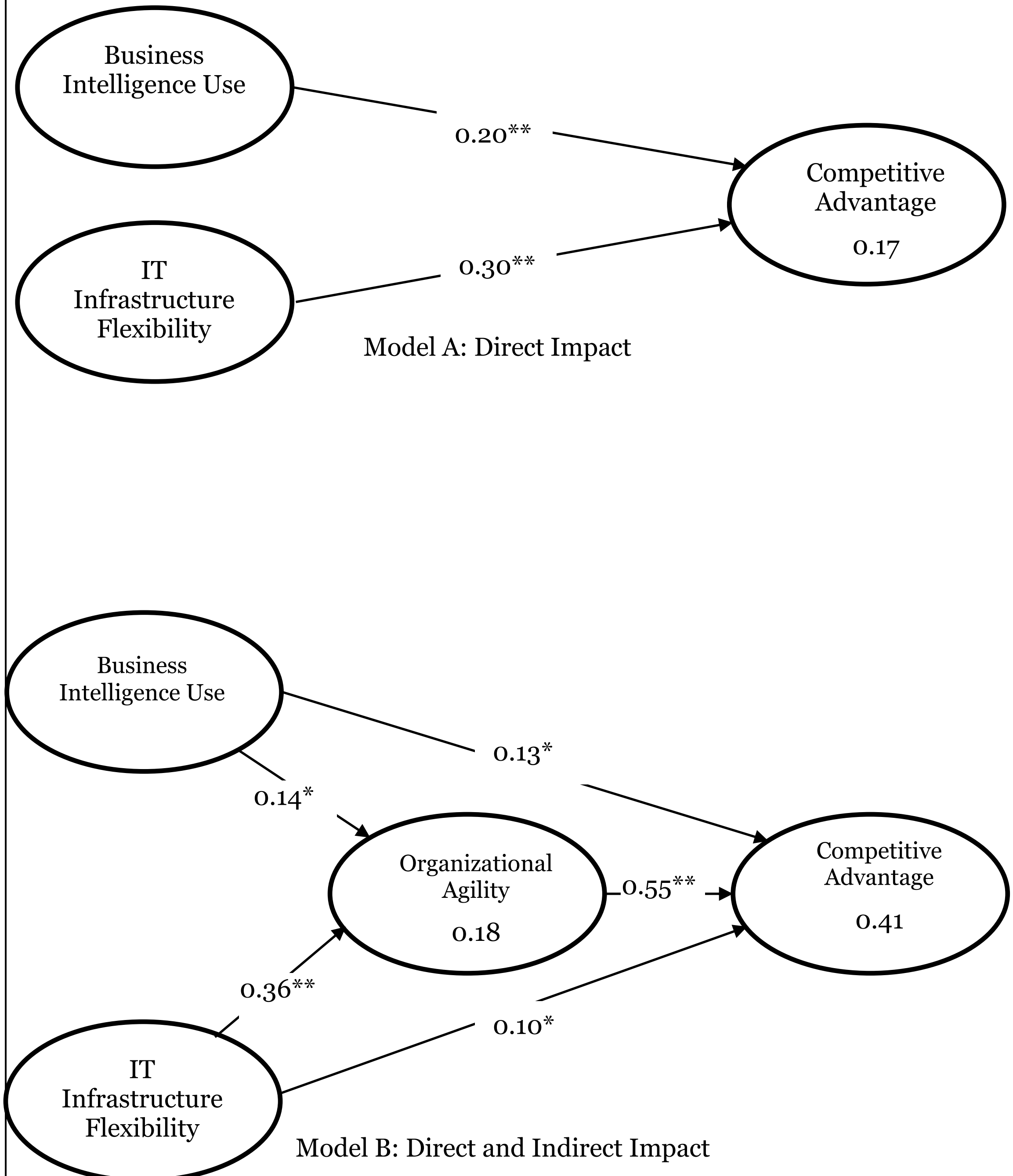

Figure 6.4.4: Mediating role of organizational agility on business Intelligence use and IT infrastructure flexibility and competitive advantage

** Significant at $p < 0.01$
*Significant at $p < 0.05$

Table 6.4.3: Hypotheses tests for the mediating roles of organizational agility

Hypothesis	Independent Variable	Dependent Variable	Mediator	Hypothesis Supported?
H9	IT Infrastructure Flexibility	Competitive Advantage	Organizational Agility	Yes
H10	Business Intelligence Use	Competitive Advantage	Organizational Agility	Yes

*Significant at $p < .05$
**Significant at $p < .01$

6.5 Discussion of Findings

This section presents the empirical findings of this study. Specifically, we discuss the assessments of the hypotheses and compare our results with other research results with similar constructs and settings.

6.5.1 Organizational Agility and Competitive Advantage

The hypothesis 1 (H_1) of this study is supported by the sample data. RBV and DCF from the strategic management discipline have suggested that dynamic capabilities and organizational agility are important strategic capabilities that help build competitive advantages. However, the propositions from the strategic management discipline are mainly theoretical. The IS discipline has presented several empirical studies that supported the positive relationship between organizational agility and competitive advantage, including, but not limited to, Sambamurthy et al. (2003), Pavlou and El Sawy (2006), Lee and Xia (2010), Pavlou and El Sawy (2010), Tallon and Pinsonneault (2011).

This study further supports the proposition that an organization's agility will positively impact its competitive advantage. As indicated in Figure 6.4.1, organizational agility has a significant impact on competitive advantage with the path coefficient of 0.60, which is significant at the 0.01 level, and $R^2 = 0.40$, which means that 40% of variance of competitive advantage can be explained by the variance in organizational agility.

6.5.2 Business Intelligence Use and Organizational Agility

This study is the first study that empirically tests the contribution of business intelligence use to organizational agility. We have argued in the theoretical development section that business intelligence can help increase organizational agility by improving the sensing and detecting dimension of organizational agility. Hypothesis 2 (H_2) is supported. The PLS tests in Figure 6.4.1 show that the path coefficient for the impact of business intelligence use on organizational agility is 0.11, which is significant at $p < 0.05$. This finding provides the first empirical support that business intelligence has strategic values. Business intelligence should be treated as a strategic component of an organization because of its contribution to organizational agility.

6.5.3 IT Infrastructure Flexibility and Organizational Agility

IT infrastructure flexibility has been extensively studied in IS research. It has been studied as an independent variable (Sambamurthy et al. 2003; Kumar 2004; Tiwana and Konsynski 2010) and moderator (Lin 2010; Tallon and Pinsonneault 2011). However, this is the first study that theoretically argued the direct contribution of IT infrastructure flexibility to organizational agility and empirically investigated the relationship between IT infrastructure flexibility and organizational agility. The PLS test results in Figure 6.4.1 show that there is a significant impact of IT infrastructure flexibility on organizational agility: the path coefficient is 0.31, which is significant at $p < 0.01$.

This finding supports that the real business values of IT infrastructure flexibility lie in the flexible interaction between IT infrastructure and its organizational context (DeJarnett et al. 2004; Kumar 2004; Lee et al. 2011). This finding provides the empirical support for Hypothesis

3 (H_3) that IT infrastructure flexibility is a key contributing component for organizational agility. Combining this finding and the finding about the relationship between business intelligence use and organizational agility, this study lends support to the claim that IT still does matter (Kumar 2004). Although some IT components may be commodities and not scarce anymore, the IT infrastructure flexibility is not just a simple combination of those components. IT infrastructure is not just a black box. From the first-order constructs of IT infrastructure flexibility and their indicators, we can see that many characteristics of IT infrastructure flexibility cannot be bought. They need to be carefully cultivated so that other organizational capabilities can benefit from a flexible IT infrastructure. A flexible IT infrastructure is a strategic source that can help increase an organization's strategic business values by enhancing its organizational agility.

In organizational agility, 32% of variance can be explained together by business intelligence use and IT infrastructure flexibility. These findings show the important roles of information systems and IT infrastructure in enabling an agile organization. Future studies need to further examine how organizations can leverage a flexible IT infrastructure to maximize the values of these IT and IS components to stay ahead of competitions.

6.5.4 IT Infrastructure Flexibility and Business Intelligence Use

Hypothesis 4 (H_4) is supported by the empirical evidence of this study. The path coefficient for the positive relationship between IT infrastructure flexibility and business intelligence use is 0.32. The path coefficient is significant at $p < 0.01$. Hypothesis 4 (H_4) in this study is the first proposition in the literature that connects business intelligence use with IT infrastructure flexibility. We argued that business intelligence systems are IT-enabled information systems. Although only 16% of variance in business intelligence use can be explained by IT infrastructure flexibility, the impact of IT infrastructure flexibility on business intelligence use is significant. A flexible IT infrastructure can help quickly integrate heterogeneous data sources, provide accurate information to decision makers where and when it is needed, and make deployed business intelligence systems useful. The usefulness of an information system can encourage its use in organizations. This proposition has been strongly supported by the empirical evidence from the sample in this study. This finding shows that to maximize the use of business intelligence, a flexible IT infrastructure should be built in organizations.

6.5.5 The Moderating Effects of Environmental Turbulence

6.5.5.1 The Moderating Effect of Environmental Turbulence on the Relationship between Business Intelligence Use and Organizational Agility

The environmental turbulence on this relationship has not been reported since there is a lack of empirical studies on business intelligence in the literature. The test results support our hypothesis 5 (H_5): the interaction path coefficient = 0.21 and is significant at $p < 0.01$. This finding suggests that environmental turbulence positively moderates the directed relationship from business intelligence use to organizational agility. It shows that business intelligence use is more important to increase an organization's agility in highly turbulent environments than in less turbulent environments.

6.5.5.2 The Moderating Effect of Environmental Turbulence on the Relationship between IT Infrastructure Flexibility and Organizational Agility

It has not been studied in IS research on the moderating role of environmental turbulence on the relationship between IT infrastructure flexibility and organizational agility. The lack of the relevant studies on this topic is because (1) many IS researchers do not distinguish flexibility and agility; (2) it has not been theorized until this study that IT infrastructure flexibility contributes to the responding dimension of organizational agility.

This study shows that environmental turbulence positively moderates (reinforces) the relationship: path coefficient = 0.15 and is significant at $p < 0.05$. This finding suggests that IT infrastructure flexibility plays a more important role to increase an organization's agility in more turbulent business environments than in less turbulent environments. Therefore, our hypothesis 6 (H_6) is supported.

6.5.5.3 The Moderating Effect of Environmental Turbulence on the Relationship between Organizational agility and Competitive Advantage

The moderating role of environmental turbulence on the relationship between organizational agility and competitive advantage has been studied before in IS research. For example, Pavlou and El Sawy (2006) investigated the moderating role of environmental turbulence on the relationship between new product development (NPD) capabilities and competitive advantage. They conceptualized NPD capability with two components: NPD dynamic capability, a strategic option component that measures an organization's ability to reconfigure existing resources to respond to opportunities and threats, and NPD functional competence, an operational component that measures the existing operation capability. They found that environmental turbulence positively moderates the relationship between dynamic capability and functional competence but negatively moderates the relationship between functional competence and competitive advantage. Tallon and Pinsonneault (2011) investigated the moderating role of environmental volatility (turbulence) on firm agility and performance (financial performance). They found that environmental volatility does moderate the relationship between organizational agility and firm performance.

This study shows that environmental turbulence positively moderates (reinforces) the relationship between organizational agility and competitive advantage: path coefficient = 0.12 and is significant at $p < 0.05$. Therefore, our hypothesis 7 (H_7) is supported by the sample data. This finding is consistent with prior studies that examined the moderating effect of environmental turbulence. It suggests that the role of organizational agility on competitive advantage is more prominent in a more turbulent environment than in a less turbulent environment.

6.5.5.4 The Moderating Effect of Environmental Turbulence on the Relationship between IT Infrastructure Flexibility and Business Intelligence Use

There is also a lack of empirical studies in the literature on the moderating role of environmental turbulence on this relationship because the paucity of empirical studies on business intelligence in extant IS research.

The test results show that environmental turbulence positively moderates (reinforces) the directed relationship from IT infrastructure flexibility to business intelligence use: the path coefficient = 0.22 and is significant at $p < 0.01$. The finding shows that IT infrastructure flexibility is more important in enabling business intelligence use in more turbulent environments than in less turbulent environments. It supports our hypothesis 8 (H_8).

6.5.6 The Mediating Effects of Organizational Agility

6.5.6.1 The Mediating Effect of Organizational Agility on the relationship between IT Infrastructure Flexibility and Competitive Advantage

We hypothesized the mediating roles of organizational agility for business intelligence use and IT infrastructure flexibility on competitive advantage. From an organizational agility perspective, business intelligence use can help sense and detect opportunities and threats and IT infrastructure flexibility can help respond to opportunities and threats easily and quickly; therefore, these two IT/IS components should have impacts on competitive advantage through organizational agility.

We tested in this study the mediating role of organizational agility for the relationship between business intelligence use and competitive advantage and between IT infrastructure flexibility and competitive advantage, using the suggested steps by Judd and Kenny (1981). Judd and Kenny's (1981, p. 605) approach requires three conditions for full mediation: (1) "the treatment affects the outcome variable"; (2) each variable in the causal chain affects the variable that follows it in the chain, when all variables prior to it, including the treatment, are controlled"; and (3) "the treatment exerts no effect upon the outcome when the mediating variables are controlled."

Based on Figure 6.4.2, there is a significantly direct impact from IT infrastructure flexibility on competitive advantage: path coefficient = 0.37 and is significant at $p < 0.01$ (model A). Based on model B, IT infrastructure flexibility has a significant impact on organizational agility (path coefficient = 0.44 and is significant at $p = 0.01$); and organizational agility, on competitive advantage (path coefficient = 0.56 and is significant at $p < 0.01$). However, the impact of IT infrastructure flexibility on competitive advantage is also significant when the mediator (organizational agility) is controlled in model B, although the significance is lower (path coefficient = 0.13 and is significant at $p < 0.05$ significant level) than that of the impact in model A. Therefore, the impact of IT infrastructure flexibility on competitive advantage is partially mediated by organizational agility at $p < 0.05$ but is fully mediated by organizational agility at $p = 0.01$. Figure 6.4.4 shows that the same conclusion can be drawn when the mediating role of organizational agility was examined with IT infrastructure flexibility and business intelligence use were included in the same model.

Although the impact of IT infrastructure flexibility on competitive advantage is not fully mediated by organizational agility at $p < 0.05$, at least part of the impact can be explained by organizational agility at this level. This partial mediation is acceptable in social science research, as a single mediator can hardly be expected to completely explain the relation between an independent and a dependent variable in many circumstances (Baron and Kenny 1986; MacKinnon et al. 2002). At $p < 0.01$, the impact of IT infrastructure flexibility on competitive advantage is fully mediated by organizational agility. From the test results, our hypothesis 9 (H_9) is supported. We can assert that IT infrastructure flexibility has its strategic value by impacting competitive advantage through organizational agility.

6.5.6.2 The Mediating Effect of Organizational Agility on the Relationship between Business Intelligence Use and Competitive Advantage

The test results for the mediating role of organizational agility in the relationship between business intelligence use and competitive advantage have the same pattern as the results for the mediating role of organizational agility in the relationship between IT infrastructure flexibility and competitive advantage.

Based on Figure 6.4.3, there is a significantly direct impact from business intelligence use on competitive advantage: path coefficient = 0.29 and is significant at $p < 0.01$ (model A). Based on model B of Figure 6.4.3, business intelligence use has a significant impact on organizational agility (path coefficient = 0.26 and is significant at $p < 0.01$); and organizational agility, on competitive advantage (path coefficient = 0.58 and is significant at $p < 0.01$). However, the impact of business intelligence use on competitive advantage is also significant when the mediator (organizational agility) is controlled in model B, although the significance is lower (path coefficient = 0.14 and is significant at $p < 0.05$) than the significance of the impact in model A. Therefore, the impact of business intelligence use on competitive advantage is partially mediated by organizational agility at $p < 0.05$ but is fully mediated by organizational agility at $p < 0.01$. Figure 6.4.4 shows that the same conclusion can be drawn when the mediating role of organizational agility was examined with IT infrastructure flexibility and business intelligence use were included in the same model.

From these test results, our hypothesis 10 (H_{10}) is supported. We can assert that business intelligence use has its strategic value by impacting competitive advantage through organizational agility.

These findings for hypotheses 9 and 10 further demonstrate that IT/IS components can create strategic values for organizations. They suggest that IT/IS components should not be studied in isolation. They need to be studied in conjunction with other organizational resources to fully understand their real business values.

Chapter 7

Implications for Research and Practice

7.1 Limitations and Suggested Future Studies

Before discussing the implications of this study for research and practice, we shall point out the limitations of this study so that the results of this study will not be overexplained and future studies can be proposed.

This study used the cross-sectional data at one point of time. This does not provide historical information on how the independent variables (IT infrastructure flexibility, business intelligence use, and organizational agility) impact the dependent variables over time. One important question in competitive dynamic research is how organizations maintain a sustained competitive advantage. This study supports the claim that IT infrastructure flexibility and business intelligence have strategic values because they interact with other key organizational capabilities that directly impact strategic components. However, to answer the question whether IT infrastructure flexibility and business intelligence can help sustain competitive advantage, a longitudinal study is required to compare the impacts of IT infrastructure flexibility and business intelligence use on competitive advantage over time. This cross-sectional design also makes it necessary to treat the results with caution because causality cannot be inferred from cross-sectional data. Nevertheless, a solid cross-sectional study provides a strong foundation for future longitudinal studies.

A single informant filled up a questionnaire. This may suggest that the results are subjected to common method bias. We took various steps to minimize the bias, which includes a priori and post hoc steps. For the priori step, we carefully developed the measures for each construct and tried to isolate dependent construct from its predictors. We used statistical tests, such as the Harman one-factor test, partial correction analysis, and correlation analysis, as the post hoc steps to make sure the common method bias is minimal. Future studies could use a matched-pair design that uses two informants from each organization. For example, one can be a technical executive and the other can be a business function executive to further alleviate common method bias.

Although the measurement indicators for competitive advantage are carefully selected and the statistical tests show the reliability and validity of the measurement scale, the construct is still a perceived measure. The actual performance may not be perfectly captured by the primary data. Future studies may use secondary data (archived data) or other objective measures as complementary methods to verify this measure.

The levels of environmental turbulence cannot be established. We tried to use traditional cluster analysis techniques to classify the environmental turbulences of the participants' organizations. Most of the organizations have the same environmental turbulence characteristics. We can only conclude that changes in environmental turbulence significantly moderate the investigated relationships. We cannot divide the participants' organizations into high- and low-turbulence environments to compare the results. Although we cannot divide the participating organizations into high and low groups, the survey does suggest that environmental turbulence plays an important role in affecting various relationships in the research model. It demonstrates that when comparing more turbulent environments with less turbulent environments, business intelligence and IT infrastructure on organizational agility use have stronger impacts, organizational agility has a stronger impact on competitive advantage, and IT infrastructure flexibility has a stronger impact on business intelligence use. Future studies may collect more data specifically from low- and high-turbulence environments to find significant differences in these investigated relationships.

The model in this study is general and it is not confined to a specific business activity. Therefore, we believe that this model can be generalized to all aspects of organizational activities. Future research can look at specific business contexts. For example, future research can study the model specifically in operation or custom relationship management to verify the applicability of the model for a specific business context.

7.2 Implications for Research

This study is one of the few empirical studies that investigate the importance of business intelligence. It uses a sound theoretical lens to argue that IT and IS components can help increase strategic values by enhancing organizational agility. The theoretical contributions of this research are several folds.

First, using the lens of organizational agility and dynamic capabilities framework, we theoretically argued and empirically investigated how BI can help increase organizations' competitive advantage and through which complementary resources BI can help enhance competitive advantage. This pioneer work provides a theoretical foundation that explains why business intelligence is important and convinces organizations to be BI based. As a pioneering research that empirically examines the effects of business intelligence from the organizational agility perspective, this research paves the way for more empirical research on business intelligence. For example, more researches need to be done on how to implement or how to use and manage business intelligence systems to further increase an organization's agility.

Second, by theorizing that IT infrastructure flexibility can help the responding dimension of organizational agility, we suggest an alternative way to view IT infrastructure as a strategic component for organizations. Through the lens of organizational agility and AMC framework, we argued that a flexible IT infrastructure is an essential part of an organization's responding capability. From this study, it is clear that IT infrastructure flexibility is a major source component to organizational agility and organizational agility has a direct impact on organizational performance (Sambamuthy et al. 2003; Lee et al. 2008). Therefore, IT infrastructure flexibility has strategic values. We suggest that future research investigates approaches and ways to build a flexible IT infrastructure.

Third, we clarify several concepts that were not well defined and have been used inconsistently in the IS research. These constructs include competitive action, competitive advantage, sustained competitive advantage, and competitive performance. We proposed that competitive action is a loose construct in the IS research. It needs to be further defined and classified on a sound theoretical base.

Fourth, we extend the existing research on IT values by providing insights on how BI and IT infrastructure flexibility can be integrated into organizational capability to enhance competitive advantage. This study answers the call to promote studies on specific information systems and their idiosyncratic effects (Mukhopadhyay et al. 1995; Pavlou and El Sawy 2010). It also answers the call for studies "to unlock the mysteries of an increasingly important, but complex, set of relationships between IT investments and firm performance" (Sambamurthy et al. 2003, p. 256).

7.3 Implications for Practice

In addition to research, this study has implications for practice. First, it provides insights on how BI interacts with other organizational resources to enhance organizational agility and competitive advantage. BI can create values with the right conditions. As an information system, the values of BI will be affected by IT infrastructure. Therefore, business intelligence systems need to be viewed as part of the big picture so that the benefits of business intelligence systems can be fully realized.

Second, it reminds organizational executives that IT infrastructure is not only a valuable platform that helps to enable communication internally and externally and to enable present and future business applications, but IT infrastructure is also a strategic component that can contribute to competitive advantage through organizational agility. Attention should be allocated to various areas of IT infrastructure, such as IT infrastructure flexibility, to fully take advantage of IT to enhance an organization's agility and competitive advantage.

Third, although prior research shows inconsistent results of implementing business intelligence systems, theoretically, business intelligence systems have strategic values because its contribution to organizational agility. Some companies have not garnered the fruits from the investments on intelligence systems probably because they have not created right conditions for implementing and using business intelligence systems. Business leaders need to continually investigate the factors that affect the performance of their business intelligence systems and provide resources to tackle the problems and issues that hinder their success in implementing business intelligence systems.

Chapter 8

Conclusion

BI has attracted much attention in the last several years from business practitioners and academic researchers. After a survey of nearly 3000 executives, managers, and analysts from more than 30 industries and 100 countries, Lavalle et al. (2011) found that the top performers use BI in the widest possible range of decisions, whereas low performers use intuition for their decisions. A MISQ special issue (guest edited by Chen et al. 2010) on BI research illustrates the growing interests in BI research in academia. As pointed out by Jourdan et al. (2008), BI research works are still in the infancy stage and many works focus on defining concepts and exploring formal theories. Following the call to study effects of specific information systems (Mukhopadhyay et al. 1995; Pavlou and El Sawy 2010), we aimed to investigate the effects of BI on an organization's competitive advantages in this research and study how different resources, especially IT resources, in an organization interact with each other to affect competitive advantages.

This study provides empirical evidence on why BI is important and how BI helps increase an organization's strategic values. It is a pioneer work in BI research to empirically test the BI importance in a business context. It can serve as a theoretical foundation that explains why organizations need to implement and promote the use of business intelligence. It shows that the effective use of a specific information system can be a source of strategic differentiation (Pavlou and El Sawy 2006). This study is also one of the first studies that examine the values of IT infrastructure from an organizational agility perspective. We theorized that IT infrastructure has strategic values because it helps one dimension of organizational agility: responding to opportunities and threats. This unique perspective makes it clear that IT infrastructure is not just an irrelevant component to business performance. It is a critical component that needs to be carefully built, and its flexibility has a strategic impact on an organization's strategic performance. The moderating effects of environmental turbulence in this study reinforced the claim that as environments become more turbulent, the strategic role of IT will become even more prominent (Pavlou and El Sawy 2006).

References

Ackoff, R. L. 1971. “Toward a System of Systems Concepts,” *Management Science* (17:11), pp. 661-671.

Akkermans, H.A., Bogerd, P., Yucesan, E. and van Wassenhove, L.N. 2003“The Impact of ERP on Supply Chain Management: Exploratory Findings from a European Delphi Study,” *European Journal of Operational Research* (146:2), pp. 284-301.

Armstrong, J.S. and Overton, T.S. 1977 “Estimating Nonresponse Bias in Mail Surveys,” *Journal of Marketing Research* (14), pp. 396-402.

Babbie, E.R. 1990 *Survey Research Methods*, Cengage Learning: Wadsworth, CA.

Bagozzi, R., Yi, Y., Phillips, L. 1991 “Assessing Construct Validity in Organizational Research,” *Administrative Science Quarterly* (36:3), pp. 421-458.

Barclay, D., Higgins, C. and Thompson, R. 1995 “The partial least squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration”, *Technology Studies*, (2:2), pp. 285-309.

Barney J. 1991 "Firm Resources and Sustained Competitive Advantage," *Journal of Management* (17:1), pp.99-120.

Baron, R.M. and Kenny, D.A. 1986 “The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations,” *Journal of Personality and Social Psychology* (51), pp. 1173-1182.

Benaroch, M. 2002 “Managing Information Technology Investment Risk: A Real Options Perspective,” *Journal of Management Information Systems* (19:2), pp. 43-84.

Benaroch, M., Lichtenstein, Y., and Robinson, K. 2006 “Real Options in Information Technology Risk Management: An Empirical Validation of Risk-Option Relationships,” *MIS Quarterly* (30:4), pp. 827-864.

Bharadwaj A. S. 2000 "A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation," *MIS Quarterly* (24:1), pp.169-196.

Bhatt G. D. andGrover, V. 2005 "Types of Information Technology Capabilities and their Role in Competitive Advantage : An Empirical Study," *Journal of Management Information Systems* (22:2), pp.253-277.

Birkinshaw, J., Morrison, A., and Hulland, J. 1995 “Structural and Competitive Determinants of a Global Integration Strategy,” *Strategic Management Journal* (16:8), pp. 637-655.

Bollen, K. A. 1989 Structural equations with latent variables, Wiley, New York.

Brandel, M., “6 hottest IT skills for 2010,” *ComputerWorld*, 2009, pp. 4, available online at http://www.computerworld.com/s/article/345529/6_hottest_IT_skills_for_2010.

Broadbent, M., Weill, P., and St. Clair, D. 1999 “The Implications of Information Technology Infrastructure for Business Process Redesign,” *MIS Quarterly* (23:2), pp. 159-182.

Burton-Jones, A. and Straub Jr, D.W. 2006 “Reconceptualizing System Usage: An Approach and Empirical Test,” *Information Systems Research* (17:3), pp. 228-246.

Bush, A.A., Tiwana, A. and Rai, A. 2010 “Complementarities between Product Design Modularity and IT Infrastructure Flexibility in IT-Enabled Supply Chains,” *IEEE Transactions on Engineering Management* (57:2), PP. 240-254.

Byrd, T.A. and Turner, D.E. 2000 “Measuring the Flexibility of Information Technology Infrastructure: Exploratory Analysis of a Construct,” *Journal of Management Information Systems* (17:1), pp. 167-208.

Byrd, T.A. 2001 “Information Technology, Core Competencies and Sustained Competitive Advantage,” *Information Resources Management Journal* (14:2), pp. 27-36.

Byrd T. A. and Turner, D. E. 2001 "An Exploratory Examination of the Relationship between Fexible IT Infrastructure and Competitive Advantage," *Information & Management* (39:1), pp. 41-52.

Campbell, D. T. and Fiske, D. W. 1959 “Convergent and Discriminant Validation by the Multitraitmultimethod Matrix,” Psychological Bulletin (56), pp.81-105.

Chaharbaghi K. and Lynch, R. 1999 "Sustainable Competitive Advantage: Towards a Dynamic Resource-Based Strategy," *Management Decision* (37:1), pp.45-50.

Chanopas, A., Krairit, D., and Khang, D.B. 2006 “Managing Information Technology Infrastructure: a New Flexibility Framework,” *Management Research News* (29:10), pp. 632-651.

Checkland, P. 1981 *Systems thinking*, Systems practice. New York: Wiley.

Chen, M.J., Hambrick, D.C. 1995 “Speed, Stealth, and Selective Attack: How Small Firms Differ From Large Firms in Competitive Behavior,” *Academy of Management Journal* (38:2), pp. 453-482.

Chen, M.J. 1996 "Competitor Analysis and Interfirm Rivalry: Toward a Theoretical Integration," *Academy of Management Review* (21:1), pp.100-134.

Chen, M.J., Su, K.H., and Tsai, W.P. 2007 “Competitive Tension: The Awareness-Motivation-Capability Perspective,” Academy of Management Journal (50:1), pp. 101-118.

Chen, H., Chiang, R., and Storey, V.C. 2010 “Call for papers for MISQ Special Issue on Business Intelligence Research,” MIS Quarterly, available online at http:// www.**misq**.org/skin/.../**misq**/pdf/Current**Call**s/SI_**BusinessIntelligence**.pdf.

Chi L. and Ravichandran, T. 2010 "Information Technology, Network Structure, and Competitive Action.Pdf," *Information Systems Research* (21:3), pp.543-570.

Chin, W. W. 1998a “The Partial Least Squares Approach to Structural Equation Modeling,” In *Modern Methods for Business Research*, G. A. Marcoulides, ed. Mahwah, NJ: Lawrence Erlbaum Associates.

Chin, W.W. 1998b “Issues and Opinion on Structural Equation Modeling,” MIS Quarterly (22:1), pp. Vii-XVI .

Chin, W. W. and Newsted, P. R. 1999 “Structural equation modeling analysis with small samples using partial least squares”, Rick Hoyle, ed., Statistical Strategies for Small Sample Research, Sage Publications, Thousand Oaks, CA, pp. 307-341.

Chin, W. W., Marcolin, B. L., and Newsted, P. R. 2003 “A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study”, *Information Systems Research* (14:2), pp. 189-217.

Chin, W.W. 2010 “How to Write Up and Report PLS Analysis,” Vinzi, V.E., Chin, W.W., Henseler, J., and Wang, H.W., ed., Handbook of Partial Least Squares: Concepts, Methods and Applications, Springer, New York.

Christopher, M. and Towill, D.R. 2002 “Developing Market specific Supply Chain Strategies,” *International Journal of Logistics Management* (13:1), pp. 1-14.

Chung, S.H., Rainer Jr., P.K., and Lewis, B.R. 2003 “The Impact of Information Technology Infrastructure Flexibility on Strategic Alignment and Application Implementations,” Communications of The Assoication for Information Systems (11), article 11, pp. 191-206.

Churchill G. A. 1979 "A Paradigm for Developing Better Measures of Marketing Constructs," *Journal of Marketing Research* (16:1), pp.64-73.

D'Aveni, R. A. 1994 *Hypercompetition: Managing the Dynamics of Strategic Maneuvering*, New York, The Free Press.

Davis, F.D. 1989 "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* (13:3), pp. 319-340.

DeJarnett, L., Laskey, R., and Trainor, H.E. 2004 "From the CIO Point of View: The "IT Doesn't Matter" Debate," *Communications of the Association for Information Systems* (13), Article 26, pp. 443-455.

Dess, G.G. and Beard, D.W. 1984 "Dimensions of Organizational Task Environments," Administrative Science Quarterly (29:1), pp. 52-73.

Duncan, N. 1995 "Capturing Flexibility of Information Technology Infrastructure: A Study of Resource Characteristics and Their Measure," *Journal of Management Information systems* (12:2), pp. 37-57.

Eckerson, W.W. 2009 "Beyond Reporting: Delivering Insights with Next-Generation Analytics," TDWI Best Practices Report, available at http://tdwi.org/webcasts/2010/06/beyond-reporting-delivering-insights-with-next-generation-analytics.aspx.

Eisenhardt K. M. and Martin, J. A. 2000 "Dynamic Capabilities: What are they?" *Strategic Management Journal* (21:10-11), pp.1105-1121.

El Sawy, O.A. and Pavlou, P.A. 2008 "IT-Enabled Business Capabilities for Turbulent Environments," *MIS Quarterly Executive* (7:3), pp. 139-150.

Elbashir, M.Z., Collier, P.A., and Sutton, S.G. 2011 "The Role of Organizational Absorptive Capacity in Strategic Use of Business Intelligence to Support Integrated Management Control Systems," *The Accounting Review* (86:1), pp. 155-184.

Erdfelder, E., Faul, F., & Buchner, A. 1996 "GPOWER: A General Power Analysis Program," *Behavior Research Methods, Instruments, & Computers* (**28**), pp. 1-11.

Ferrier, W.J., Smith, K.G., and Grimm, C.M. 1999 "The Role of Competitive Action in Market Share Erosion and Industry Dethronement: A Study of Industry Leaders and Challengers," *Academy of Management Journal* (42:4), pp. 372-388.

Ferrier, W.J. 2001 "Navigating the Competitive Landscape: the Drivers and Consequences of Competitive Aggressiveness," *Academy of Management Journal* (44:4), pp. 858-877.

Ferrier, W.J., Holsapple, C.W., Sabherwal, R. 2007 "Call for papers – Information Systems Research Special issue: Digital Systems and Competition," *Information Systems Research* (18:2), pp. 228-230.

Fichman, R.G. 2004 "Real Options and IT Platform Adoption: Implications for Theory and Practice," *Information Systems Research* (15:2), pp. 132-154.

Fink L. and Neumann, S. 2007 "Gaining Agility through IT Personnel Capabilities : The Mediating Role of IT Infrastructure Capabilities," *Journal of the Association for Information Systems* (8:8), pp.440-462.

Fornell, C., and Larker, D. 1981 "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error", *Journal of Marketing Research* (18), pp. 39-50.

Gallagher K. P. and Worrell, J. L. 2007 "Organizing IT to Promote Agility," *Information Technology and Management* (9:1), pp.71-88.

Gartner 2008 "Making the Difference: The 2008 CIO Agenda," available at http://www.gartner.com/it/page.jsp?id=587309.

Gartner 2009 "Fundamentals of Data Warehousing for CIO," available at http://www.gartner.com/id=949212.

Gefen, D. and Straub, D. 2005 “A Practical Guide to Factorial Validity Using PLS-Graph: Tutorial and Annotated Example,” *Communications of the Association for Information Systems* (16), pp. 91-109.

Gessner, G. H. and Volonino, L. 2005 “Quick Response Improves Return on Business Intelligence Investments,” *Information Systems Management* (22:3), pp. 66–74.

Ghemawat, P. 1991 *Commitment: The Dynamic of Strategy*, New York: The Free Press.

Gimeno, J. 1999 “Reciprocal Threats in Multmarket Rivalry: Staking out ‘Spheres of Influence’ in the U.S. Airline Industry,” Strategic Management Journal (20:2), pp. 101-128.

Gnyawali D. R., Fan, W., and Penner, J. 2010 "Competitive Actions and Dynamics in the Digital Age: An Empirical Investigation of Social Networking Firms," *Information Systems Research2* (21:3), pp.594-613.

Goldman, S. L., Nagel, R. N., and Preiss, K. 1995 *Agile Competitors and Virtual Organizations: Strategies for Enriching the Customer*, New York, Van Nostrand Reinhold.

Grahovac J. and Miller, D. J. 2009 "Competitive Advantage and Performance: The Impact of Value Creation and Costliness of Imitation," *Strategic Management Journal* (1212:October 2006), pp.1192-1212.

Grant, R. M. 1995. *Contemporary Strategy Analysis*. Blackwell Publishing, Oxford, UK.

Groves, R.M. 2006 “Nonresponse Rates and Nonresponse Bias in Household Surveys,” *Public Opinion Quarterly* (70:5), pp. 646-675.

Hair, J. F., Jr., Anderson, R. E., Tatham, R. L., and Black, W. C. 1998 Multivariate Data Analysis with Readings, 5th Edition. Englewood Cliffs, NJ: Prentice Hall.

Hedrick, T., Bickman, L., & Rog, D. 1993 *Applied Research Design*. Newbury, California: Sage Publications Inc.

Helfat, C. E. and Peteraf, M. 2003 “The Dynamic Resource-based View: Capability Lifecycles,” *Strategic Management Journal* (24), pp. 997–1010.

Henseler, J., Ringle, C.M., and Sinkovics, R.R. 2009 “The Use of Partial Least Squares Path Modeling in International Marketing,” *Advances in International Marketing* (20), pp. 277-319.

Hitt, M., Keats, B., and DeMarie, S. 1998 “Navigating in the New Competitive Landscape: Building Strategic Flexibility and Competitive Advantage in the 21st Century,” *Academy of Management Executive* (12:4), pp. 22-41.

Hobbs G. 2010 "Agility in Information Systems : Enabling Capabilities for the IT Function,” *Pacific Asia Journal of the Association for Information Systems* (2:4), Article 2. Available at: http://aisel.aisnet.org/pajais/vol2/iss4/2

Hofer, C. W., & Schendel, D. 1978 *Strategy Formulation: Analytical Concepts,* St. Paul, MN: West.

Holland, J. H. 1998. *Emergence: From Chaos to Order*, NewYork: Perseus Books.

Holsapple, C. W. & Li, X. 2008 “Understanding Organizational Agility: A Work Design Perspective,” In *Proceedings of the International Command and Control Research and Technology Symposium*, July 17-19, Seattle.

Hulland, J. 1999 “Use of Partial Least Squares (PLS) in Strategic Management Research: A Review of Four Recent Studies.” *Strategic Management Journal* (20:2), pp. 195–204.

Jackson, M. C. 2000. *Systems Approaches to Management*, NewYork: Springer.

Jacobson R. 1992 "The Austrian School of Strategy," *The Academy of Management Review* (17:4), pp.782-807.

Johannesson, J. and Palona, I. 2010 "Environmental Turbulence and the Success of a Firm's Intelligence Strategy: Development of Research Instruments," *International Journal of Management* (27:3), pp. 448-458.

Jourdan, Z., Rainer, R.K., and Marshal, T.E. 2008 "Business Intelligence: an Analysis of the Literature," Information Systems Management (25), pp. 121-131.

Jaworski B. J. and Kohli, A. K. 1993 "Market Orientation: Antecedents and Consequences," Journal of Marketing, (57), pp.53-70.

Judd, C.M., and Kenny, D.A. (1981) "Process Analysis: Estimating Mediation in Treatment Evaluations," *Evaluation Reviews* (5), pp. 602-619.

Kearns, G. S., and Lederer, A. 2003. "A Resource-Based View of Strategic IT Alignment: How Knowledge Sharing Creates Competitive Advantage," *Decision Sciences* (34:1), pp. 1-29.

Kirchner, W. K. and Mousley, N.B. 1963 "A nNote on Job Performance: Differences between Respondent and Nonrespondent Salesmen to an Attitude Survey," *Journal of Applied Psychology* (47), pp. 223-244.

Kline, R. B. 2005 *Principles and practice of structural equation modeling*, *2nd ed.,* The Guilford Press, New York and London.

Kohli, R. and Grover, V. 2008 "Business Value of IT: An Essay on Expanding Research Directions to Keep up with the Times," *Journal of the Association for Information Systems* (9:1), pp. 23-39.

Kumar, R. 2004 "A Framework for Assessing the Business Value of Information Technology Infrastructures," *J. Management Information Systems* (21:2), pp.11–32.

Lahrmann, G., Marx, F., Winter, R., and Wortmann, F. 2011 "Business Intelligence Maturity: Development and Evaluation of a Theoretical Model," In *Proceedings of the 44th Hawaii International Conference on System Sciences*.

Laursen, G.H.N. and Thorlund, J. 2010 *Business Analytics for Managers: Taking Business Intelligence Beyond Reporting*, Wiley.

LaValle, S., Lesser, E., Shockley, R., Hopkins, M.S., and Kruschwitz, N. 2011 "Big Data, Analytics and the Path from Insights to Value," *MIT Sloan Management Review* (52:2), pp. 21-32.

Lee, One-Ki (Daniel) , Sambamurthy, Vallabh, Lim, Kai and Wei, K. K. 2008 "IT-Enabled Organizational Agility and Sustainable Competitive Advantage" (August 23, 2008). Available at SSRN: http://ssrn.com/abstract=1249301.

Lee, G. and Xia, W. 2010 "Toward Agile: An Integrated Analysis of Quantitative and Qualitative Field Data on Software Development Agility," *MIS Quarterly* (34:1), pp.87-114.

Lee, S, Song, J., Baker, J., Kim, Y., and Wetherbe, J. C. 2011 "The Commoditization of IT: Evidence from a Longitudinal Text Mining Study," *Communications of the Assoication for Information Systems* (29), Article 12, pp. 221-242.

Li, X., Chen, C., Goldsby, T.J. and Hosapple, C.W. 2008 "A Unified Model of Supply Chain Agility: the Work-Design Perspective," *International Journal of Logistics Management* (19:3), pp. 408-435.

Li, S., Shang, J., and Slaughter, S. A. 2010 "Why do Software Firms Fail? Capbilities, Competitive Actions, and Firm Survival in the Software Industry," *Information Systems Research* (21:3), pp.631-654.

Lin, Shuai-fu, 2010 "The Complementary Effect of Manufacturing Process Modularity and IS Flexibility on Agility in Manufacturing," In *Proceedings of American Conference of Information Systems,* Paper 118.

Lonnqvist, A. and Pirttimaki, V. 2006 "The Measurement of Business Intelligence," Information Systems Management (23:1), pp. 32-40.

Luftman, J. and Ben-Zvi, T. 2010 "Key Issues for IT Executives 2009: Difficult Economy's Impact on IT," MIS Quarterly Executive (9:1), pp. 49-59.

Luhn, H.P. 1958 "A Business Intelligence System," IBM Journal of Research and Development (2:4), pp. 314-319.

Lyytinen K. and Rose, G. M. 2006 "Information System Development Agility as Organizational Learning," *European Journal of Information Systems* (15:2), pp.183-199.

MacKinnon, D.P., Lockwood, C.M., Hoffman, J.M., West, S.G., and Sheets, V. 2002 "A Comparison of Methods to Test Mediation and Other Intervening Variable Effects," *Psychological Methods* (7:1), pp. 83-104.

Mahoney J. T. and Pandian, J. R. 1992 "No Title," *Strategic Management Journal,* (13:5), pp.363-380.

Marjanovic, O and Roose, R. 2011 "BI-Enabled, Human-Centric Business Process Improvement in a Large Retail Company," in Proceedings of the 44th Hawaii International Conference on System Sciences.

Melville, N., Kraemer, K., and Gurbaxani, V. 2004 "Review: Information Technology and Organizational Performance: an Integrative Model of IT Business Value," *MIS Quarterly* (28:2), pp. 283-322.

Mishra, A.N. and Agarwal, R. 2010 "Technological Frames, Organizational Capabilities, and IT Use: An Empirical Investigation of Electronic Procurement," *Information Systems Research* (21:2), pp. 249-270.

Mithas, S., Ramasubbu, N., and Sambamurthy 2011 "How Information Management Capability Influences Firm Performance," *MIS Quarterly* (35:1), pp. 237-256.

Mukhopadhyay, T., Kekre, S., and Kalathur, S. 1995 "Business Value of Information Technology: A Study of Electronic Data Interchange," *MIS Quarterly* (19:2), pp. 137-156.

Muller, R.M., Linders, S., and Pires, L.F. 2010 "Business Intelligence and Service-Oriented Architecture: A Delphi Study," *Information Systems Management* (27), pp. 168-187.

Neuman, L., W. 2003 *Social Research Methods*. Boston: Allyn and Bacon.

Nevo, S. and Wade, M.R. 2010 "The Formation and Value of IT-Enabled Resources: Antecedents and Consequences of Synergistic Relationships," *MIS Quarterly* (34:1), pp. 163-183.

Newell, S., Swan, J., and Robertson, M. 1998. "A Cross-National Comparison of the Adoption of Business Process Reengineering: Fashion Setting Networks?," *Journal of Strategic Information Systems* (7:4), pp. 299-317.

Nidumolu, S. R. and Knotts, G. W. 1998 "The Effects of Customizability and Reusability on Perceived Process and Competitive Performance of Software Firms," *MIS Quarterly* (22:2), pp.105-137.Niederman, F., Bancheau, J.C. and Wetherbe, J.C. 1991 "Information Systems Management Issues in the 1990s," *MIS Quarterly* (15:4), pp. 474-499.

Niederman, F., Brancheau, J.C., and Wetherbe, J.C. 1991 "Information Systems Management Issues for the 1990s," *MIS Quarterly* (15:4), pp. 475-500.

Nunnally, J. C. and Berbstein, I. 1994 *Psychometric Theory*, New York: McGraw-Hill,

Overby, E., Bharadwaj, A., and Sambamurthy, V. 2006 "Enterprise Agility and the Enabling Role of Information Technology," *European Journal of Information Systems* (15:2), pp. 120-131.

Pavlou, P.A. and El Sawy, O.A. 2006 “From IT Leveraging Competence to Competitive Advantage in Turbulent Environments: The Case of new Product Development,” *Information Systems Research* (17:3), pp. 198-227.

Pavlou, P.A. and El Sawy, O.A. 2010 “The ‘Third Hand’: IT-Enabled Competitive Advantage in Turbulence Through Improvisational Capabilities,” *Information Systems Research* (21:3), pp. 442-471.

Penrose, E. T. 1959 *The Theory of the Growth of the Firm,* New York: Wiley.

Peteraf, M. 1993 "The Cornerstones of Competitive Advantage: A Resource-based View," *Strategic management Journal* (14), pp. 179-191.

Peteraf, M. A., and Barney, J. B. 2003 "Unraveling the Resource-Based Tangle," *Managerial & Decision Economics* (24:4), pp. 309-323.

Pinsonneault, A., & Kraemer, K. 1993 “Survey research methodology in management information systems: An assessment. *Journal of Management Information Systems, (10*:1), 75-106.

Podsakoff, P.M., Mackenzie, S.B., Podsakoff, N.P., and Lee, J.Y. 2003 “Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies,” *Journal of Applied Psychology* (88:5), pp. 879-903.

Porter, M. E. 1980 *Competitive Strategy*, New York: The Free Press.

Porter, M. E. 1985 *Competitive Advantage,* New York: The Free Press.

Preston, D. S., and Karahanna, E. 2009. “Antecedents of IS Strategic Alignment: A Nomological Network,” *Information Systems Research* (20:2), pp. 159-179.

Rai, A., Patnayakuni, R., Seth, N. 2006 “Firm Performance Impacts of Digitally Enabled Supply Chain Integration Capabilities,” *MIS Quarterly* (30:2), pp. 225-246.

Rai, A. and Tang, X.L. 2010 "Leverage IT Capabilities and Competitive Process Capabilities for the Management of Interorganizational Relationship Portfolios,” *Information Systems Research* (21:3), pp. 516-542.

Reich, B. H., and Benbasat, I. 1996. “Measuring the Linkage Between Business and Information Technology Objectives,” *MIS Quarterly* (20:1), pp. 55-81.

Ringle, C.M., Wende, S., and Will, A. 2005 SmartPLS, available at http://www.smartpls.de.

Robinson, J. P., Shaver, P. R., and Wrightsman, L. S. 1991 “Criteria for Scale Selection and Evaluation”, in Robinson, J. P., Shaver, P. R., Wrightsman, L.S. (Eds), *Measures of Personality and Social Psychological Attitudes*, San Diego: Academic Press, pp.1-15.

Rosnow, R.L. and Rosenthal, R.G. 1998 “Beginning Behavior Research: A Conceptual Primer”, 3rd ed., Prentice-Hall, IL.

Sambamurthy, V., Bharadwaj, A., and Grover, V. 2003 “Shaping Agility through Digital Options: Reconceptualizing the Role of IT in Contemporary Firms,” *MIS Quarterly* (27:2), pp. 237-263.

Sax, L.J., Gilmartin, S.K., and Bryant, A.N. 2003 “Assessing Response Rates and Nonresponse Bias in Web and Paper Surveys,” Research in Higher Education (44:4), pp. 409-432.

Seo D., Miranda, J., and Paz, A. L. 2010 "Role of Information Systems in Organizational Agility : The Case of eClasSkeduler at Universidad De Chile,” *AMCIS 2010 Proceedings. Paper 578.*
http://aisel.aisnet.org/amcis2010/578

Schlueter Langdon, C. 2006 “Designing Information Systems Capabilities to Create Business Value: A Theoretical Conceptualization of the Role of Flexibility and Integration,” *J. Database Management* (17:3), pp.1–18.

Seah, M., Hsieh, M.H., and Weng, P.D. 2010 “A Case Analysis of Savecom: The Role of Indigenous Leadership in Implementing a Business Intelligence System,” *International Journal of Information Management* (30), pp. 368-373.

Smith K. G., Grimm, C. M., Gannon, M. J., Chen, M., Grimm, C. M., Gannon, M. J. 1991 "Organizational Information Processing, Competitive Responses, and Performance in the U.S. Domestic Airline Industry," *Academy of Management Journal* (34:1), pp.60-85.

Swafford, P.M., Ghosh, S., and Murthy, N. 2006 "The Antecedents of Supply Chain Agility of a Firm: Scale Development and Model Testing,” *Journal of Operations Management* (24:2), pp. 170-188.

Tallon P. P. andPinsonneault, A. 2011 "Competing Perspectives on the Link between Strategic Information Technology Alignment and Organizational Agility: Insights from a Mediation Model," *MIS Quarterly* (35:2), pp.463-486.

Teece, D.J. and Pisano, G. 1994 *The Dynamic Capabilities of Firms: an Introduction*, Oxford University Press.

Teece, D.J., Pisano, G., and Shuen, A. 1997 “Dynamic Capabilities and Strategic Management,” *Strategic Management Journal* (18:7), pp. 509-533.

Teece D. J. 2007 "Explicating Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance," *Strategic Management Journal* (1350:August), pp.1319-1350.

Tiwana, A. and Konsynski, B. 2010 “Complementarities between Organizational IT Architecture and Governance Structure,” *Information Systems Research* (21:2), pp. 280-304.

Trkman, P., McCormack, K., Oliveira, M.P.V., and Ladeira, M.B. 2010 “The Impact of Business Analytics on Supply Chain Performance,” *Decision Support Systems* (49), pp. 318-327.

Vannoy S. a. and Salam, a. F. 2010 "Managerial Interpretations of the Role of Information Systems in Competitive Actions and Firm Performance: A Grounded Theory Investigation," *Information Systems Research* (21:3), pp.496-515.

Venkatesh, V. and Davis, F.D. 2000 “A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies,” *Management Science* (46:2), pp. 186-204.

Venkatraman, N. and Henderson, J.C. 1998 “Real Strategies for Virtual Organizing,” *Sloan Management Review* (40:1), pp. 33-48.

Von Bertalanffy, L. 1968. *General Systems Theory*, New York: Braziller.

Wang, P., and Ramiller, N. C. 2009. “Community Learning in Information Technology Innovation,” *MIS Quarterly* (33:4), pp. 709-734.

Wang, P. 2010 “Chasing the Hottest IT: Effects of Information Technology Fashion on Organizations,” MIS Quarterly (34:1), pp. 63-85.

Watson, H. J., Goodhue, D. L., and Wixom, B. H. 2002 "The Benefits of Data Warehousing: Why Some Organizations Realize Exceptional Payoffs," *Information & Management* (39:6), pp. 491-502.

Watson, H. J., Wixom, B. H., Hoffer, J. A., Anderson-Lehman, R., and Reynolds, A. M. 2006 “Real-Time Business Intelligence: Best practices at Continental Airlines,” *Information Systems Management* (23:1), pp. 7–18.

Watson, H.J. and Wixom, B.H. 2007 “Enterprise Agility and Mature BI Capabilities,” *Business Intelligence Journal* (12:3), pp. 4-6.

Watson, H.J. 2009 "Tutorial: Business Intelligence - Past, Present, and Future,” *Communications of the Association for Information Systems* (25), Article 39, pp. 487-510.

Wernerfelt B. 1984 "A Resource-Based View of the Firm," *Strategic Management Journal* (5:4), pp.171-180.

Wiseman, F. 1972 “Methodological Bias in Public Opinion Surveys,” Public Opinion Quarterly (36), pp. 105-108.

Wixom, B. and Watson, H.J. 2010 “The BI-Based Organization,” *International Journal of Business Intelligence Research* (1:1), pp. 13-28.

Wright, S., Eid, E.R., and Fleisher, C.S. 2009 "Competitive Intelligence in Practice: Empirical Evidence from the UK Retail Banking Sector,” *Journal of Marketing Management* (25:9-10), pp. 941-964.

Yeoh, W. and Koronios, A. 2010 “Critical Success Factors for Business Intelligence Systems,” *Journal of Computer Information Systems*, pp. 23-32.

Yusuf, Y.Y., Sarhadi, M., and Gunasekaran, A. 1999 “Agile Manufacturing: the Drivers, Concepts and Attributes,” *International Journal of Production Economics* (62:1-2), pp. 33-43.

Young G., Smith, K. G., Grimm, C. M. 1996 "Austrian Perspectives Activity and on Industrial and Organization Competitive Performance," *Organization Science* (7:3), pp. 243-254.

Zaheer, A. and Zaheer, S. 1997 “Catching the Wave: Alertness, Responsiveness, and Market Influence in Global Electronic Networks,” *Management Science* (43:11), pp. 1493-1509.

Zhang, Z. and Sharifi, H. 2000 “A Methodology for Achieving Agility in Manufacturing Organizations,” *International Journal of Production Management* (20:4), pp. 496-512.

Appendix I: Survey Questionnaire (The cross-over indicators are not included in the final analyses)

Business Intelligence Use

QB1: My organization uses business intelligence systems to extract values of key performance indicators (KPI).
QB2: My organization uses business intelligence systems to get operational reporting.
QB3: My organization uses business intelligence systems to get tactical reporting.
QB4: My organization uses business intelligence systems to get strategic reporting.
QB5: My organization uses features of business intelligence systems to compare and contrast different aspects of the data.
QB6: My organization uses features of business intelligence systems to test different assumptions against data.
QB7: My organization uses features of business intelligence systems to derive insightful conclusions from data.
QB8: My organization uses features of business intelligence systems to get regular, standardized reports on key performance indicators.
QB9: My organization uses features of business intelligence systems to drill down into data to understand the root causes of exceptions.
QB10: My organization uses features of business intelligence systems for on-the-fly analysis of current and past data.
QB11: My organization uses features of business intelligence systems for querying.
QB12: My organization uses features of business intelligence systems for statistical analysis.
QB13: My organization uses features of business intelligence systems to share insights based on data within the organization.

IT Infrastructure Flexibility

Connectivity (Adapted from Tallon and Pinsonneault 2011)

QI1: My organization has a high degree of information systems inter-connectivity.
QI2: Information systems in my organization are sufficiently flexible to incorporate electronic connections to external parties.
QI3: Remote users can seamlessly access centralized data in our information systems.
QI4: Data is captured and made available to everyone in my organization in real time using information systems.

Hardware Compatibility (Adapted from Tallon and Pinsonneault 2011)

QI5: Software applications can be easily transported and used across multiple information systems platforms in my organization.

QI6: Our information systems user interfaces provide transparent access to all platforms and applications.

QI7: My organization offers multiple information systems interfaces or entry points (e.g., web access) to external users.

QI8: My organization makes extensive use of information systems middleware (systems that help connect heterogeneous information systems platforms) to integrate key enterprise applications.

Modularity (Adapted from Tiwana and Konsynski 2010; Tallon and Pinsonneault 2011)

~~QI9: Our information technology components are highly interoperable in my organization.~~

QI10: The inter-dependencies of software/hardware components are well-understood in my organization.

~~QI11: Software/hardware components are loosely coupled in my organization.~~

~~QI12: Software/hardware components are highly modular in my organization.~~

QI13: Information technology standards are well established at the enterprise-wide level in my organization.

QI14: Information technology polices are well established and implemented at the enterprise-wide level in my organization.

QI15: Information technology architecture is well established at the enterprise-wide level in my organization.

QI16: Compliance guidelines for information technology applications are well established at the enterprise-wide level in my organization.

QI17: Compliance guidelines for information technology infrastructure are well established at the enterprise-wide level in my organization.

~~QI18: Functionality can be quickly added to critical applications based on end-user requests.~~

~~QI19: My organization can easily handle variations in data formats and standards.~~

Organizational Agility

Customer Agility (Adapted from Tallon and Pinsonneault 2011)

QO1: My organization can easily and quickly respond to changes in aggregate consumer demand.

QO2: My organization can easily and quickly customize a product or service to suit an individual customer.

QO3: My organization can easily and quickly react to new products or services launched by competitors.

Operation Agility (Adapted from Tallon and Pinsonneault 2011)

QO4: My organization can easily and quickly introduce new pricing schedules in response to changes in competitors' prices.

QO5: My organization can easily and quickly expand into new markets.

QO6: My organization can easily and quickly change (i.e., expand or reduce) the variety of products/services available for sale.

Partner Agility (Adapted from Tallon and Pinsonneault 2011)

QO7: My organization can easily and quickly adopt new technologies to produce better, faster and cheaper products and services.

QO8: My organization can easily and quickly switch suppliers to take advantage of lower costs, better quality or improved delivery times.

Environmental Turbulence

Market Turbulence (Adapted from Jaworski and Kohli 1993 and Pavlou and El Sawy 2006)

~~QE1: The environmental turbulence in our industry is high.~~

QE2: New product/service introductions are very frequent in this industry.

~~QE3: There are many competitors in this industry.~~

QE4: The environment in our industry is continuously changing.

~~QE5: Environmental changes in our industry are very difficult to forecast.~~

QE6: In our line of business, customers' preferences change quite a lot over time.

QE7: Our customers tend to look for new products/services all the time.

~~QE8: We are witnessing demand for our products/services from customers who have never bought them before.~~

~~QE9: New customers tend to have needs that are different from those of our existing customers.~~

~~QE10: We do not cater to many of the same customers that we used to in the past.~~

Technological Turbulence (Adapted from Jaworski and Kohli 1993)

QE11: The technology in our industry is changing rapidly.

QE12: Technological changes provide big opportunities in our industry.

QE13: A large number of new products/services have been made possible through technological breakthroughs in our industry.

QE14: Technological developments in our industry are rather major.

Competitive Advantage

Product Cost Efficiency (Adapted from Nidumolu and Knotts 1998)

QC1: My organization has the ability to produce products/services at a lower cost compared to our competitors.

QC2: My organization has the ability to charge competitive prices for products/services compared to our competitors.

QC3: My organization has higher efficiency in producing products/services compared to our competitors.

Market Responsiveness (Adapted from Nidumolu and Knotts 1998)

QC4: My organization has the ability to respond quickly to new customer needs compared to our competitors.

QC5: My organization has the ability to better tailor products/services to individual customer needs compared to our competitors.

QC6: My organization has the ability to quickly enter new product/service markets compared to our competitors.

QC7: My organization has a better rate of introduction of new products/services compared to our competitors.