

**BUSINESS INTELLIGENCE SYSTEMS USE TO LEVERAGE ENTERPRISE-WIDE  
ACCOUNTING INFORMATION IN SHARED DATA ENVIRONMENTS**

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## **Abstract**

The implementation of enterprise systems has facilitated the development of shared data environments within organizations and conjointly the capability for broader based management control systems (MCS). Yet, several studies have found that most organizations have experienced little change in their MCS post-ERP implementation with few organizations experiencing the broad integration of MCS cross-functionally that effectively leverage enterprise data for the support of strategic decision making and operational efficiencies. Business Intelligence (BI) systems are now widely adopted as a key facilitator for extracting and analyzing the enterprise-wide data captured in these shared data environments. We examine the implementation of BI systems into enterprise system environments in order to better understand the organizational factors that influence successful assimilation across the diverse range of control systems desired in contemporary MCS. Our results indicate that organizational knowledge creation strategies are critical to having an appropriate technology infrastructure in place and to having operational-level managers that are prepared to assimilate BI supported MCS for strategic use and organizational benefit. Further, the findings show that while the Top Management Team plays a significant role in effective deployment of BI systems, their impact is indirect, and is a function of operational managers absorptive capacity. This indirect effect suggests a bottom-up driving of technology innovation as opposed to the top-down, top-management driven innovation traditionally perceived to dominate MCS implementation.

**Keywords:** business intelligence, management control systems, knowledge creation, absorptive capacity, real option, management accounting systems, strategic information systems, shared data environments, enterprise systems, enterprise resource planning systems

# **BUSINESS INTELLIGENCE SYSTEMS USE TO LEVERAGE ENTERPRISE-WIDE ACCOUNTING INFORMATION IN SHARED DATA ENVIRONMENTS**

## **I. INTRODUCTION**

Enterprise systems (e.g. enterprise resource planning systems—ERP) are fundamentally tied to the work of accounting and have had transformative implications for the integration of organizational information and for the control systems governing organizations (Chapman 2005). Conceptually, the advantages and potential of shared data environments with a broader spectrum of data have been a topic of continued interest since the 1960s (e.g. Sorter 1969; McCarthy 1979; 1982; Dunn and McCarthy 1997; Geerts and McCarthy 2002). Most of the discourse on shared data environments over the past 25 years has focused on the Resource-Events-Agent (REA) model (McCarthy 1982). While contemporary enterprise systems, such as SAP, continue to include implementation compromises that fall short of true REA specifications (O’Leary 2004), enterprise systems do provide a high level of shared data from across the organization. Despite the high levels of shared data, recent studies reveal that this data is not leveraged by many organizations within their management control systems (MCS) (e.g. Granland and Malmi 2002; Dechow and Mouritsen 2005; Quattrone and Hopper 2005; Rom and Rohde 2007). Only a few studies report on organizations who have implemented fundamental change in their MCS post-enterprise systems implementation that leverage enterprise data for the support of strategic decision making and operational efficiencies (e.g. Caglio 2003; Scapens and Jazayeri 2003; Quattrone and Hopper 2005).

In this study, we focus specifically on the assimilation of business intelligence (BI) systems<sup>1</sup> with a focus on the underlying knowledge creation activities that lead to successful

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<sup>1</sup> BI software is analytical software designed to facilitate data mining of the underlying enterprise database “for analyzing revenue and cost drivers, launching profit improvement initiatives, measuring and managing business

use/deployment of this type of strategic MCS. Assimilation goes beyond implementation, which has been the focus of much of the MCS adoption literature, to the actual scope and use of the system. Thus, BI assimilation represents the extensive use of BI systems to support, shape, and enable business strategies and value chain activities of the organization (Chatterjee et al. 2002). Assimilation represents an important outcome in the chain of technology development that begins at organizational adoption of a strategic information system and ends at the impact of the system on organizational performance (Armstrong and Sambamurthy 1999; Chatterjee et al. 2002; Liang et al. 2007). The focus on assimilation reflects the fact that the significant value from BI will not be fully realized until its implicit MCS functionalities are assimilated into an organization's strategy and business activities.

Prior studies on the impact of enterprise systems on MCS design and use highlight several factors that appear to influence an organization's ability to leverage the enterprise-wide data. Primary among these factors appear to be top management's understanding of the potential value that can be derived from enterprise databases (Bradford and Florin 2003; Caglio 2003; Nicolaou 2004), the effort put into the design and deployment of the enterprise system (Granlund and Malmi 2002; Dechow and Mouritsen 2005; Quattrone and Hopper 2005), and the preparedness of operational-level managers for adapting to the changing environment (Caglio 2003; Nicolaou 2004; Rikhardsson and Kraemmergard 2006).

Notably among the successes, the top management team and operational-level managers all exhibited an ability to adapt to complex systems and leverage the availability of enterprise-wide data. This is important as it is indicative of a *dynamic perspective* of organizational knowledge as opposed to the *static perspective* common to most of the extant literature on

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performance, and deploying decision support applications such as activity-based costing (ABC), supply chain analytics, customer analytics, scorecards, dashboards, optimization models, and simulations (Williams 2004).”

strategic information systems assimilation. Prior assimilation studies have drawn on knowledge-based perspectives and examine the influence of technical and managerial knowledge on assimilation (Boynton et al. 1994; Fichman and Kemerer 1997; Armstrong and Sambamurthy 1999; Purvis et al. 2001). Some of these studies have drawn on the absorptive capacity perspective which suggests that organizational innovation is influenced by the organization's ability to value, assimilate, and apply new knowledge for business purposes (Cohen and Levinthal 1990). However, most of these studies focus on the *static perspective* of organizational knowledge with less attention to the mechanisms through which organizations create and use knowledge to support strategic activities. The contemporary knowledge management literature criticizes this perspective of organizational knowledge (Nonaka 1994; Cook and Brown 1999; Nonaka et al. 2000). For instance, Nonaka and colleagues argue that when the concern is innovation, the passive and static view of an organization as an information-processing machine does not adequately explain the firm's innovativeness level. This issue seems particularly acute in the case of BI assimilation.

Prior IT assimilation studies that built on the absorptive capacity perspective have not focused on factors which the extant literature suggests are necessary elements for building an organization's absorptive capacity (Cohen and Levinthal 1990; Kim 1998; Zahra and George 2002a; Harrington and Guimaraes 2005). These elements include intensity of effort, knowledge creation mechanisms, and communication channels. Lack of these elements diminishes the organization's absorptive capacity (Cohen and Levinthal 1990; Kim 1998). We address these limitations by adopting Nonaka's (1994) *dynamic perspective* of knowledge creation which allows us to examine the influence of organizational absorptive capacity on BI assimilation.

Accordingly, the purpose of our study is to explore how an organization's absorptive

capacity, at both strategic and operational levels, contributes to the successful assimilation of BI systems to support advanced MCS. We develop an integrative model that theorizes relationships between the strategic and operational levels of absorptive capacity, and the impact on the existing IT infrastructure in order to improve our understanding of how organizations assimilate BI. We test the model using data collected from 347 business units who implemented similar BI software from a single vendor. Our results indicate organizational absorptive capacity is fundamental to both the readiness of the technology infrastructure for supporting BI integration and the successful assimilation of BI into advanced MCS.

The remainder of this paper is divided into four sections. The first section draws from theory on strategic information systems assimilation and the *dynamic perspective* of knowledge creation to develop a model of BI assimilation that should be generalizable to other advanced MCS. The second section details the research methods, operationalization of the variables of interest, and the data collection process. The third section details the results while the fourth and final section provides discussion of the results and considers opportunities for future research.

## **II. THEORY AND HYPOTHESES**

The push for shared data environments came about in the late 1960s when “it became apparent that computerized data processing facilities would affect major changes in the way companies maintain their corporate stores of data” (McCarthy 1982, 554). The first major advance in this area came with the REA model which represents a generalized framework for accounting information systems based on shared data environments. The REA model explicitly recognizes the need for this shared data to provide a broader view of business events that supports both accountants and non-accountants (McCarthy 1982). This need for a broader view of an organization’s activities has long been embraced by MCS researchers (see Chenhall 2003

for a review). Still, recent research in MCS demonstrates the on-going evolution of MCS with foundational MCS viewed as focusing on budgeting issues while advanced MCS cover a broader range of strategic views on human resources, product development, sales/marketing, and customer acquisitions costs (Davila and Foster 2005; 2007). Davila and Foster (2007) also find that CEOs who rely on MCS covering only financial data tend to have shorter tenures than CEOs that implement broader-based MCS that provide a clearer picture of the overall organizational performance and opportunities.

The adoption of enterprise systems by organizations and the resulting impact on MCS have been studied with great anticipation given the first real delivery of broad levels of shared data. The expectations were that enterprise systems would automate mundane MCS tasks and open the opportunity for broader-based MCS that better supported management's strategic analyses and enhanced analysis and decision making at the operational level (Sutton 1999; Granlund and Malmi 2002; Chapman 2005; Dechow and Mouritsen 2005; Quattrone and Hopper 2005; Arnold 2006). While this transformation is prevalent in some organizations (e.g. Granlund and Malmi 2002; Caglio 2003; Scapens and Jazayeri 2003; Quattrone and Hopper 2005), most studies report little change in MCS as available enterprise-wide data is often simply extracted for use by the same MCS modules that existed prior to enterprise system implementation (Granlund and Malmi 2002; Dechow and Mouritsen 2005; Rikhardsson and Kraemmergard 2006; Rom and Rohde 2007). Simply implementing enterprise systems appears insufficient to achieve significant change in organizations' MCS. Enterprise systems provide highly integrative databases, but the ability for the average user to extract relevant data without the aid of BI applications is limited (Chou et al. 2005; Carte et al. 2005). Early reviews of successes in assimilating BI into MCS highlight the critical role of culture and technology infrastructure (Carte et al. 2005).

Assimilation studies are by definition *post-adoption studies* that assume the decision to adopt a technology has been made and acceptance and diffusion of the system is complete (Chatterjee et al. 2002). Assimilation studies focus on the culture surrounding these adoptions and the resulting assimilation of the strategic information system of interest. Figure 1 provides an overview of the conceptual model for BI assimilation that we propose in this study. The model is motivated by absorptive capacity theory (Cohen and Levinthal 1990; Zahra and George 2002) and a resource-based view (Barney 1991; Mata et al. 1995; Wade and Hulland 2004). The model focuses on three critical factors affecting BI assimilation: top management team's absorptive capacity, operational managers' absorptive capacity, and sophistication of the IT architecture.

*[Please insert Figure 1 about here]*

### **TMT's Role in Organizational Learning**

The top management team (TMT) refers to a small group of the most influential executives who have overall responsibility for an organization (Hambrick and Mason 1984; Armstrong and Sambamurthy 1999). TMT includes the Chief Executive Officer (CEO), Chief Financial Officer (CFO), Chief Operational Officer (COO), amongst other senior executives. While MCS studies often highlight the critical role of top management (Anderson and Young 1999; Bhimani 2003; Davilo and Foster 2005; Naranjo-Gill and Hartman 2006; Davilo and Foster 2007), TMT knowledge has received limited attention in either the MCS or the information systems assimilation literature. TMT knowledge is a primary indicator of TMT's competence, which in turn has been expected to facilitate system assimilation (Armstrong and Sambamurthy 1999; Basselier et al. 2003). However, Armstrong and Sambamurthy (1999) did not find that the level of TMT knowledge was related to information systems assimilation.

We revisit TMT knowledge using a dynamic view of organizational knowledge which

provides a richer explanation for the role of TMT in BI assimilation. In doing so, TMT's absorptive capacity is used to capture TMT's knowledge and the ability of TMT to put that knowledge into practice. TMT's absorptive capacity is a better determinant of the ability of TMT to provide an effective leadership role and support for BI assimilation. We also argue that the effect of TMT's absorptive capacity on BI assimilation is best conceptualized as indirect, mediated by operational management's absorptive capacity.

Consider the case experience documented by Caglio (2003) where the CFO on his own volition moved into the driving force behind the design and implementation of the enterprise system. In the course of taking this lead, the CFO empowered the financial accounting function to the point where it took over what was previously the financial and management accounting functions and transformed it into an organization-wide business reporting function through advanced MCS capability. The management accountants were retrained to take on more of an analytic role for the TMT as well as a consulting role to the operational and line managers. Most in the management accounting unit moved into the operational area of the firms to focus on this analysis and support role with the diffusion of management accountants covering a broad range of functional areas such as research and development, plant management, marketing and sales, and the IT function. Hence, the CFO's quick adaptation to the enterprise system and his rapid acquisition of knowledge allowed him to be an effective force in the implementation, but the actual individuals that implemented the changes and facilitated the transformation of the two accounting functions were the financial and management accountants at the operational level who also quickly acquired new knowledge to facilitate the transformation.

This organization's experience is consistent with beliefs that organizations who engage in learning and knowledge discovery activities will be able to overcome the knowledge barriers and

become among the first adopters of new technologies (Attewell 1992; Fichman and Kemerer 1997). Following Attewall's (1992) view on organizational learning and innovation, we draw on Cohen and Levinthal's (1990) work on absorptive capacity theory which suggests that an organization's absorptive capacity facilitates learning and in turn determines the level of organizational innovation. An organization's absorptive capacity is the ability of the organization to value, assimilate, and apply new knowledge to a commercial end (Cohen and Levinthal 1990).

This definition of absorptive capacity suggests that the organization's absorptive capacity is built upon three capabilities: value, assimilation, and application. (1) *Value capability* refers to the organization's ability to recognize new knowledge, whether received from internal or external sources. This capability requires the organization to possess prior related knowledge and expertise that is relevant to the new knowledge. (2) *Assimilation capability* refers to the organization's ability to analyze, process, interpret, and understand the new knowledge (Zahra and George 2002a). (3) *Application capability* refers to the ability of the organization to use the new knowledge to support an organization's activities and strategies. The three capabilities are combinative in nature as they build upon each other to create the dynamic capability of the organization. This also suggests that an organization's absorptive capacity is path dependent, as prior relevant knowledge must exist in order to facilitate assimilation and use of new knowledge. An organization's absorptive capacity reflects the level of competence of its members, which is the knowledge they possess and their ability to exploit that knowledge into practice (Basselier et al. 2003). Cohen and Levinthal (1990) also suggest that both *prior relevant knowledge* and *intensity of effort* are critical elements for developing effective absorptive capacity. Intensity of effort represents time and energy that the members of the organization allocate to solve daily problems and create new knowledge. The two elements of absorptive capacity are presented in

Figure 2 as reported in Kim (1998). The absorptive capacity of the organization will be at its highest level when both the effort (i.e. action) and prior relevant knowledge are high (cell 1). The absorptive capacity will be at the lowest level when both prior relevant knowledge and knowledge-related activities are low (cell 4). Organizations possessing high prior knowledge combined with low intensity of effort will lose their absorptive capacity (cell 2). Prior IT assimilation studies which draw on absorptive capacity theory use technical and managerial IT knowledge as proxies for prior relevant knowledge (Boynton et al. 1994; Fichman and Kemerer 1997; Armstrong and Sambamurthy 1999). However, less attention was paid to the intensity of effort or the interaction between the two elements of absorptive capacity. As a result, these studies fail to capture the organization's overall absorptive capacity. We use the knowledge creation modes suggested in Nonaka's (1994) framework to operationalize the organizational absorptive capacity and overcome the limitations of measures used in prior research.

*[Please place Figure 2 about here]*

Absorptive capacity resides in the individuals, subdivisions, and teams within an organization and can therefore be examined at different levels (Cohen and Levinthal 1990; Jansen et al. 2005; Vincent 2005). In this study, an organization's absorptive capacity is examined at two levels: (1) at the TMT (strategic) level and (2) at the operational level.

The dynamic perspective of organizational knowledge (knowledge creation processes) is consistent with a large body of current knowledge management literature (Dittilo 2004; Vera-Munoz et al. 2006). This literature argues that a firm's knowledge is determined by its dynamic capabilities of knowledge creation rather than the stock of knowledge that organizations possess (hereafter referred to as a static view of knowledge) (Nonaka 1994; Grant 1996; Cook and Brown, 1999; Nonaka et al. 2000). Most IT assimilation studies that have considered

organizational knowledge view knowledge as static in terms of the quantity and nature of knowledge that people possess. Cook and Brown (1999), among many scholars, criticize research on organizational knowledge for its static view of the nature of knowledge (see Nonaka 1994; Kim 1995; Nonaka and Toyama 2003). Cook and Brown (1999) refer to this traditional understanding of organizational knowledge as the *epistemology of possession* because organizational knowledge is treated as something people possess.

### **Absorptive Capacity and BI Assimilation**

A high level of BI assimilation requires the development of the relevant knowledge and skills which enable the alignment of the software to the organization's business strategies and supporting MCS (Mata et al. 1995; Fichman and Kemerer 1997; Armstrong and Sambamurthy 1999). The organizational absorptive capacity is a high-order dynamic capability which is built through different combinative capabilities (such as knowledge creation mechanisms). Such capabilities are used by organizations to embody individuals' absorptive capabilities, at different levels, into the organization's routine and practice (Kogut and Zander 1992; Nonaka 1994; Kim 1998; Van den Bosch et al. 1999). Therefore, organizational absorptive capacity reflects the level of competence attributed to the members of an organization (Szulanski 1996; Zahra and George 2002a; Basselier et al. 2003). We capture an organization's absorptive capacity at two levels:

*TMT's absorptive capacity* represents the collective ability of TMT members to recognize the value of new knowledge gathered from both internal and external sources, assimilate that knowledge, and apply it to support their leadership roles including, strategic planning, resource allocation, and recognizing competitive opportunities. TMT's absorptive capacity is determined by the broader knowledge and expertise that TMT members possess as well as knowledge creation activities, including interaction with operational-level managers, competitors, customers, and peers (Applegate and Elam 1992; Nambisan et al. 1999; Daghfous 2004).

*Operational-Level Managers' Absorptive Capacity* refers to the ability of managers at the operational level to value new knowledge, assimilate it, and apply it to support the organization's business strategy and value chain activities. The

absorptive capacity at the operational level is developed through various mechanisms including top management intervention and focused knowledge creating activities, cross-functional teams, etc. (Boynton et al. 1994; Fichman and Kemerer 1997; Jansen et al. 2005).

Studies reporting on successful improvement of MCS post-enterprise systems implementation reveal several success factors such as knowledge creation activities, among others. In one case, half the management accountants were trained early on analytical tasks to facilitate the transformation (Granlund and Malmi 2002). In another case, the management accountants devoted time to understanding products and process technology, business operations, marketing and sales, and strategic objectives (Caglio 2003). Caglio also notes the diffusion of the management accountants across the operational and line functions in cross-functional teams served to will lead to enhance operational level managers' leveraging of the enterprise data. This is consistent with the view that operational managers with higher absorptive capacities will be able to form effective partnerships which enable them to learn about different aspects of the organization's business strategies and potential MCS improvements (Szulanski 1996; Nelson and Coopriider 1996). As such, operational-level absorptive capacity is crucial for BI assimilation. This leads to H<sub>1</sub>:

**H<sub>1</sub>:** *Higher levels of operational-level managers' absorptive capacity will positively enhance organizations' BI assimilation.*

As the organization's leaders, TMT play a key role in organizational learning and the level of assimilation. TMT's absorptive capacity determines TMT competency and their ability to undertake an effective leadership role in various organizational projects (Daft and Weick 1984; Basselier et al. 2003). TMT leadership roles can be viewed from two perspectives; external and internal leadership (Ulrich and Wiersema 1989; Kakabadse et al. 1995). External leadership roles include the ability of TMT to interact with the changing environment and interpret this into

internal vision (Daft and Weick 1984; Hambrick 1995). The internal leadership roles of TMT include the design and management of employees' actions which enable the realization of the organization's vision (Kakabadse et al. 1995; Anderson and Young 1999; Caglio 2003; Chenhall and Euske 2007). This process requires assessing the gap between the current reality of the organization and the new vision that the organization aims to achieve whilst identifying the amount of organizational learning needed to fill the gap (Senge 1990; Granlund and Malmi 2002). This includes introducing knowledge creation mechanisms which enable filling in the knowledge gaps at the operational level, which is needed to support new strategies and any enabling technologies (Keen 1991; Nonaka et al. 1998; Caglio 2003). Sharing of information between TMT and operational managers in order to define the scope of MCS can be viewed as critical to the effectiveness of the MCS (Bhimani 2003).

Identifying and remediating knowledge gaps is critical as the assimilation of the technology will be dependent on those at the operational level understanding what is possible from a BI system and increasing their IT literacy to a level conducive with effective implementation (Rikhardsson and Kraemmergard 2006). This is observable in the successful implementations of enterprise systems where assimilation of the technology was limited only by how quickly operational managers could aggregate the related skills (Granlund and Malmi 2002; Caglio 2003). This dependency on operational-level learning suggests the relation between TMT's absorptive capacity and BI assimilation is mediated by operational-level absorptive capacity, leading to the following hypotheses:

**H2:** *TMT's absorptive capacity will positively enhance the operational level-managers' absorptive capacity.*

**H2a:** *TMT's absorptive capacity will positively enhance organizations' BI assimilation, through the operational-level managers' absorptive capacity.*

## **IT Infrastructure Sophistication and BI Assimilation**

IT infrastructure sophistication refers to “the extent to which an organization has diffused the key information technologies into its foundation for supporting business applications” (Armstrong and Sambamurthy 1999, p. 309). IT infrastructure sophistication reflects the diversity and integration of IT components that comprise an organization’s IT infrastructure. Viewed through real options theory, investment in IT infrastructure can be viewed as similar to buying an option that enables new and follow-on IT projects to be implemented and used effectively (Kambil et al. 1993; Broadbent et al. 1999; Sambamurthy et al. 2003; Fichman 2004).

BI is an example of a follow-on product designed to leverage off the enterprise systems implementation. Various implementation decisions at the enterprise systems level could affect the viability of BI in facilitating the development of an advanced MCS. Among these are the need for a well-built data warehouse (Granlund and Malmi 2002) and the willingness to make tough choices at the implementation level to capture more complex data and routines (Quattrone and Hopper 2005; Dechow and Mouritsen 2005).

Accordingly, we posit that organizations which have sophisticated IT infrastructures will be able to assimilate BI software into their value chain activities and business strategies far more extensively than competitors lacking such IT infrastructure sophistication. Organizations with sophisticated IT infrastructure will be able to use BI effectively and achieve *operational effectiveness* and *strategic positioning* simultaneously. These two outcomes are essential to exhibit higher BI assimilation, facilitate advanced MCS development, and consequently greater competitive performance (Porter 1996; Tallon et al. 2000). This leads to H<sub>5</sub>:

**H3:** *The sophistication of IT infrastructure will positively enhance an organization’s BI assimilation.*

## **Absorptive Capacity and IT Infrastructure Sophistication**

IT users at the operational level are important sources of IT innovation. Their interaction with customers, suppliers and competitors enables them to gather valuable information which can be exploited by IT professionals in relevant IT projects (von Hippel 1994; Nambisan et al. 1999). In an enterprise systems environment, these users are also capable of driving the systems configuration (Caglio 2003; Rikhardsson and Kraemmergard 2006; Byrne and Pierce 2007).

Operational-level managers' absorptive capacity enables line and IT managers to develop effective working partnerships and to exploit new information received from external sources and convert them into appropriate IT infrastructure development proposals (Byrd et al. 2004). How the system is implemented can directly affect the information availability for achieving MCS objectives (Quattrone and Hopper 2005). Supporting advanced MCS capabilities necessitates highly complex systems configurations that are only possible through high levels of operational-level absorptive capacity (Dechow and Mouritsen 2005). This leads to the following hypothesis:

**H4:** *Operational-level managers' absorptive capacity will positively enhance the IT infrastructure sophistication of the organization.*

TMT contributes to various IT infrastructure-related activities including project planning, resource allocation, and user problem solving. However, building sophisticated IT infrastructure to support various IT applications requires a sound understanding of the organization's strategic intent and context as well as knowledge about the types of IT infrastructure services required to support the strategic context (Broadbent et al. 1999). TMT with higher absorptive capacity will be able to undertake a broader view and plan for organization-wide IT infrastructure that aligns with business strategy and supports future IT projects. This leads to the following hypothesis:

**H5:** *TMT's absorptive capacity will positively enhance the IT infrastructure sophistication of the organization.*

## Control Variables

Prior studies suggest a number of ancillary factors can influence IT assimilation. Prior studies highlight the following as influencing IT assimilation: Time since adoption (Anderson and Young 1999), TMT's knowledge (static view), CIO/senior IT managers' knowledge (static view), Operational managers' shared knowledge (static view) and firm size (Davila and Foster 2005; 2007). These factors are modeled as control variables in order to provide a clearer view of the primary influences on BI assimilation:

*Time since adoption of BI* was used to control for effects of the necessary know-how that the organization develops internally or acquires from external sources throughout the period since BI software was first adopted. The longer the time since BI was first adopted the higher expertise the organization will likely develop (Purvis et. al. 2001).

*Senior Leadership Knowledge* includes *top management team's strategic IT knowledge* and *CIO/Senior IT managers' knowledge*. These two variables are included in the research model to control for managerial IT knowledge, from the static perspective, as suggested in prior IT assimilation studies (Armstrong and Sambamurthy 1999).

*Operational managers' shared knowledge* refers to an understanding and appreciation among IS and line managers for the technologies and processes that affect their mutual performance. We control for operational managers' static IT knowledge.

*Firm size* has been used to proxy for the resource base of the organization. Large firms are well-prepared to support the development of high quality IT infrastructure, and foster various learning activities to support BI users (Armstrong and Sambamurthy 1999; Subramani 2004; Davilo and Foster 2005; 2007). Two proxies were used to measure firm size: number of employees and gross revenue of the firm. (Zhu and Kemerer 2002; Zhu et. al. 2003; Subramani 2004; and Liang et. al. 2007).

## III. RESEARCH METHOD

To test the research hypotheses we used a field survey method. The survey was distributed to Australian client organizations of a single international vendor providing BI software. The vendor is the provider for one of the major BI systems used internationally. Focusing on the customer base of a single vendor controls for the potential variation that may occur from differences in functionality and usability provided by different BI vendors.

Surveys were distributed to 1,873 managers in 612 organizations based on the BI vendor provided contact list of clients (subject to a written non-disclosure agreement). Where possible, multiple respondents from each organization were selected from the vendor's contact list to include senior executives, operational managers, and IT users. For a "small organization" which only had a single contact person, the organization was selected if the contact person was a senior executive (e.g. chief executive officer (CEO), chief financial officer (CFO), or chief information officer (CIO)). A multiple respondent strategy was preferred for the richness of the data, to mitigate bias, and to enhance accuracy (Sethi and King 1994; Huber and Power 1985).

The survey protocol followed the guidance of Dillman (2000). Survey packets including a cover letter, survey, and reply-paid envelope were mailed to each selected contact. A first reminder was sent four weeks later to all the recipients by e-mail. A second survey packet was sent four weeks after the e-mail reminder to all non-respondents. A final reminder was e-mailed two weeks later with a URL link to the web-based version of the survey. On-line surveys have been used in prior studies for both sole and supplementary survey methods (Chatterjee et al. 2002; Dillman 2000). Our tests revealed no difference between on-line and paper responses.

An average of 3 respondents in each targeted organization received the survey. Respondents from organizations with multiple strategic business units (SBUs) were asked to choose whether to answer the survey on behalf of either a SBU, or on behalf of the whole enterprise. This option aims to improve the accuracy of responses. A total of 436 responses were received from 229 organizations including 65 on-line responses. Due to significant missing data on the main variables of the study, 17 responses were deemed unusable. This resulted in 419 usable responses for a usable response rate of 22% and 36% per individual and organization

respectively.<sup>2</sup> The responses included 135 who chose to identify and respond on behalf of their SBUs. Including responses for SBUs and responses for organizations as a whole, the final sample consists of 347 organizational units.

The average age of respondents was 41.1 years, with 16.5 years of work experience. Eighty percent of respondents were male and 20% were female. Respondents classifying themselves as business executives/managers comprised 54%, with 46% IT executives/managers and 13% holding both business and IT jobs. Fifty-four percent of respondents reported between 5–8 years of experience with BI systems, while 26% had more than eight years of experience. Responses were predominantly from large organizations with an average of 663 employees and gross revenue of a little over A\$2 billion. Industry information is provided in Table 1.

*[Please insert Table 1 about here]*

Early and late responses were compared in paired samples of 150, 100, 50, and 40 using an ANOVA test for non-response bias. The results show no significant differences on any of the study variables, including demographic and control variables. There is no indication of any non-response bias.

To test the consistency of the responses, correlation of multiple responses from the same organization on the main constructs were computed (see Armstrong and Sambamurthy (1999) for details of the method). All correlations between two or more respondents from the same organization on the main constructs are significant ( $p < .01$ ). The results provide strong evidence of the consistency between responses from a single organization. As a consequence, average scores from multiple respondents were used as the organizational response. For organizations

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<sup>2</sup> In addition, 91 respondents reported that they were not the correct informants to answer the survey. Another 70 sent their apology by email and often quoted reasons for not responding to the survey.

with a single respondent, the individual response is used to represent the organization. No significant differences were found between the two response types—i.e. individual and averaged.

Exploratory Factor Analysis (EFA) was used to perform Harman's one-factor test for common method variance (Podsakoff and Organ 1986). The results of the two EFA tests show that there are more than three "unrotated" factors that account for the variance in the measurement items used. This result suggests that there is no significant common method variance that threatens the quality of the data (Zhuang and Lederer 2003).

### **Operationalization of Constructs**

**BI Assimilation** is measured by adapting Armstrong and Sambamurthy's (1999) instrument. Building on Porter's value chain framework, Armstrong and Sambamurthy used a total of fourteen items to measure assimilation, six of which capture IT assimilation in different business activities and eight items to measure IT assimilation in business generic strategies. Armstrong and Sambamurthy report three dimensions for IT assimilation: IT assimilation in logistics activities, IT assimilation in marketing activities, and IT assimilation in business strategies. A comparison of factors in Armstrong and Sambamurthy's measure with those identified by the literature as representative of advanced MCS suggest most attributes that involve enterprise data are captured. One item, "managerial processes", was added which captures additional attributes of advanced MCS not covered by Armstrong and Sambamurthy's measure. The additional factor yielded a total of 15 items for the measure.

Exploratory factor analysis (EFA) supported the use of only 13 items. Two items were eliminated from the measurement list because they had high cross-loadings (more than or closer to the threshold of 0.50). The result from the EFA analysis shows the remaining 13 items loaded on three factors of BI assimilation: In this study, these factors are referred to as: (1) *business*

*production and operations*, (2) *customer relations*, and (3) *marketing and sales*. Each factor combines both generic strategies and the business activities related to a specific business function.

***Organizational Absorptive Capacity.*** Absorptive capacity, as defined earlier, is the ability of the organization to recognize the value of new knowledge, assimilate it, and apply it to commercial ends (Cohen and Levinthal 1990). The measures of absorptive capacity at the TMT and operational levels used in this study are drawn on Nonaka's (1994) dynamic theory of organizational knowledge creation. Nonaka (1994) and Nonaka and Takeuchi (1995) suggest that organizational knowledge creation is captured by four modes of knowledge conversion: *socialization* (the process of creating tacit knowledge through shared experience), *externalisation* (the process of converting tacit into explicit knowledge), *combination* (the process of creating explicit knowledge from explicit knowledge), and *internalisation* (the process of converting explicit knowledge into tacit knowledge). Each of the four modes creates new knowledge of specific type, and the dynamic between the four modes enables organizational knowledge creation. The four knowledge creation mechanisms represent the organization's ability to assimilate new knowledge from internal and external sources, convert it into new usable knowledge and apply it to support strategic planning and execution of business strategies (Davenport and Prusak 1998; Alavi 2000; George and Zahra 2002a).

***Operational-Level Absorptive Capacity.*** The measure of absorptive capacity at the *operational level* was adapted from three prior studies (Becerra-Fernandez and Sabherwal 2001; Choi and Lee 2002) which used Nonaka's (1994) four modes of knowledge conversion processes. However, the three studies were conducted in three different countries (Japan, US, and South Korea) and the measurement items used in these three studies are not the same. One

concern was that some items used could be driven by the country's specific culture, which may not be relevant to Australian organizations. To overcome this concern the knowledge creation measures reported in the three papers were synthesized. To improve the validity of measure, items that are in common in at least two of the three instruments were chosen for the initial measurement draft. The initial measurement draft was then subjected to a number of pilot-tests including interviews with senior managers, feedback from academics, two focus group meetings, and a small survey. As a result of the pilot testing, seven additional items were added to the initial measurement list. The final measure of knowledge conversion modes at the operational level consists of twenty-five items divided between socialization (seven items), externalization (six items), combination (five items), and internalization (seven items).

EFA supported the use of only 22 items to measure the operational-level absorptive capacity. Three items (KCO 5, KCO 8, and KCO 9) were eliminated from the operational-level absorptive capacity measure because they loaded below .50 on the relevant dimension (Hair et. al. 1998). As discussed in the results section, the CFA analysis showed the 22 items support the four factors of Nonaka's (1994) organizational knowledge creation.

***TMT's Absorptive Capacity.*** The measurement of knowledge creation mechanisms at the *strategic level* was developed by drawing on Nonaka's (1994) four modes of knowledge conversion, in addition to, top management team literature (Hambrick, 1981, 1995; Hurst et. al. 1989; Kakabadse et. al. 1995; Kippenberger 1997; Wu et. al. 2002). Thirty-one items were included in the initial measurement draft. The initial measurement items were discussed with two senior managers and a knowledge management consultant. The three managers were asked in three separate meetings: (1) whether the items included in the list represent the knowledge creation processes that usually take place at the TMT level and (2) whether there are any

additional knowledge creation processes relate to the TMT that should be included. This process was followed by a number of pilot-tests including feedback from academics, two focus group meetings, and a small survey. Feedback received from participants at the pilot tests was analyzed and incorporated in the measurement draft when appropriate. Twenty-six items were included in the final survey representing the four conversion processes: socialization (seven items), externalization (six items), combination (six items), and internalization (seven items).

EFA supported the use of only 19 items to measure TMT's absorptive capacity. Seven items (KCS6, KCS9, KCS10, KCS11, KCS14, KCS20, KCS21) were eliminated from the measurement list because they loaded below .50 on the relevant factor (Hair et. al. 1998).

***IT infrastructure sophistication.*** The measurement of IT infrastructure sophistication was measured using a scale adapted from Armstrong and Sambamurthy (1999). The scale was refined to include item measures for technical infrastructure components necessary for BI systems as identified through reviews of the related enterprise systems literature and interviews with business managers and technology consultants. Further refinement was completed based on the results of two focus group meetings. The final measurement list includes 10 key components of IT infrastructure representing two categories of infrastructure: (1) *generic IT* infrastructure is the base IT infrastructure for future business applications (i.e., enterprise applications, computing and network, IT standards, and security and risk management policy), and (2) *specialized infrastructure*, which includes infrastructure components used specifically to support business intelligence software (i.e., data warehouses, data marts, and data mining).

To determine the level of *IT infrastructure sophistication* respondents were asked to indicate the extent to which their organizations had *diffused* the 10 components within their organization's IT infrastructure. EFA tests confirmed that 9 items loaded onto 2 factors identified

as *generic IT infrastructure* and *specialized IT infrastructure*. One item was removed because it loaded below 0.50 on both factors. All the constructs tested in this study are modeled using reflective indicator measurement models (or molecular models for second-order constructs), which is consistent with the source of the instruments.

## **Data Analysis**

We use Partial Least Square (PLS) to both validate our constructs and test the research model and hypotheses. PLS simultaneously tests the psychometric properties of the scales used to measure the constructs (i.e. measurement model) and examines the strength of the relations between the constructs (i.e. structural model). PLS is more appropriate than the covariance-based SEM techniques (such as LISREL) in cases, as in this research, where the goal of the research is explaining variance, and the research model is complex (Fornell and Bookstein 1982; Chin 1998a, 1998b; Hulland 1999; Gosain et al. 2004).<sup>3</sup>

## **Measurement Properties**

Multiple tests suggested by Churchill (1979) and Straub (1989) were performed to assess construct validity and reliability. First, either EFA or CFA (confirmatory factor analysis), depending on the maturity of the measure, was conducted to examine the dimensions and loading of the measurement items. Second, the structural model and the measurement models were tested simultaneously using PLS analysis. The output from PLS in relation to the measurement model was used to verify the initial results from the EFA (CFA) tests. Item loadings were used to assess the significance of the item to the factor. Items with loadings below 0.70 were dropped from the construct measure because they indicate that less than 50% of the variance of the variable is

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<sup>3</sup> A multivariate normality test was conducted using AMOS 5 (Mardia 1970). The result shows that the data used are multivariate non-normal ( $t = 24.55$ ,  $P < 0.001$ ). Therefore, covariance-based SEM techniques such as AMOS and LISREL are not appropriate. PLS was chosen since it does not require the data to exhibit multivariate normal distribution (Gefen et al. 2000; Chin et al. 2003).

accounted for by the factor (Hair et al. 1998). However, a less strict rule of thumb was followed where 0.60 was used for newly introduced measurement items (Chin 1998b; Hulland 1999).

### **Construct Validity**

**Convergent validity:** Item loading together with the average variance extracted (AVE) were used in the study to examine the convergent validity of each construct's measure (Van den Bosch 1999). Table 2 shows that all measurement items have significant loadings which indicate their significant contribution to the measured construct. Moreover, AVE for all the constructs was in excess of 0.50 (ranging between 0.51 and 0.80) which demonstrates the convergent validity of the measurement items (Fornell and Larcker 1981). This also indicates that each of the measured constructs explain more than 0.50 of the variation in the observed variables.

*[Please insert Table 2 about here]*

**Discriminant validity:** Table 3 shows the values of the square root of the AVE (on the diagonal) are all greater than the inter-construct correlations (off the diagonal). This demonstrates that the measures exhibit satisfactory discriminant validity. An additional test of discriminant validity was conducted where each measurement item was assessed to ensure that it has a higher loading on its assigned factor than on the other factors (Chin 1998; Gefen et al. 2000) (see Table 4). Each of the measurement items loaded higher on the appropriate construct than on the other constructs (Chin 1998; Gefen et al. 2000). These results further support the adequacy of the discriminant validity of the measures used in this study.

*[Please insert Tables 3 and 4 about here]*

## **IV. RESULTS**

PLS Graph 3.0 with bootstrapping as a resampling technique was used to estimate the structural model and the significance of the paths. Paths coefficients and the  $R^2$  are used jointly

to evaluate the model (Chin 1998). Table 5, 6 and Figure 3 present the PLS analysis results. As shown in Table 5, none of the control variables included in the research model (firm size, time since adoption, TMT knowledge, CIO knowledge, and operational level managers' shared knowledge) is significantly related to BI assimilation. The five control variables used in the study proxy for organizations' slack resources, including physical resources (size), experience with BI (time since adoption), and managerial IT knowledge (TMT and CIO knowledge).

*[Please insert Tables 5, 6 and Figure 3 about here]*

Overall, the results suggest the model has good predictability. The coefficients for all paths between the constructs in the model, except one, are statistically significant at the .05 level of significance. The results also indicate that 24% of BI assimilation, 46% of operational-level absorptive capacity, and 18% of IT infrastructure sophistication were explained by the model.

### **Hypotheses Testing**

Hypotheses were tested within the structural equation model shown in Figure 3. Hypotheses which posit direct relations between constructs (H<sub>1</sub>, H<sub>2</sub>, H<sub>3</sub>, H<sub>4</sub>, H<sub>5</sub>) were tested based on the magnitude and significance of path coefficients estimated using PLS Graph 3.0. Hypotheses which posit mediated (indirect) relations (H<sub>2a</sub>) were tested by using approaches suggested in prior literature to calculate the magnitude and significance of mediated paths (Hoyle and Kenny 1999; Subramani 2004). Additional tests were conducted to examine whether the indirect path in H<sub>2a</sub> fully or partially mediates (Baron and Kenny 1986; Mathieson et. al. 2001). (A description of the procedures used to test for mediation is provided in the appendix).

Table 5 provides the magnitude and significance of inter-construct relationships. The results of hypotheses testing are summarized below:

- **Hypothesis 1, supported:** The path from operational-level absorptive capacity to BI

assimilation (structural link = .28,  $p < .001$ ) is positive and significant (Table 6).

- **Hypothesis 2, supported:** The path from TMT's absorptive capacity to operational-level absorptive capacity (structural link = .68,  $p < .001$ ) is positive and significant (Table 6).
- **Hypothesis 2a, supported:** The analysis of individual mediated paths indicates that operational-level absorptive capacity mediates the link between TMT's absorptive capacity and assimilation of BI. The indirect path (indirect link = .19,  $p < .001$ ) is positive and significant (Table 7). Additional tests also suggest that the relation between TMT's absorptive capacity and BI assimilation is fully mediated by operational-level absorptive capacity (Table 8).
- **Hypothesis 3, supported:** The path from IT infrastructure sophistication to BI assimilation (structural link = .20,  $p < .05$ ) is positive and significant (Table 6).
- **Hypothesis 4, supported:** The path from operational-level absorptive capacity to IT infrastructure sophistication (structural link = .42,  $p < .001$ ) is positive and significant (Table 6).
- **Hypothesis 5, not supported:** The path from TMT's absorptive capacity to IT infrastructure sophistication (structural link = -.01,  $p > .10$ ) is unexpectedly negative but insignificant (Table 6).

## V. DISCUSSION OF RESULTS AND CONCLUSION

BI software possesses many potential functions, and when configured and used effectively can provide a broad array of data analysis support for advanced management control systems (MCS) that support strategic planning and execution of business strategies. However, as prior literature suggests, many organizations have not been able to leverage the capabilities of similar MCS investments in their business strategies and value chain activities. With the objective of better understanding and explaining the assimilation of advanced MCS, this study constructs and tests a research model which addresses limitations in prior research through an examination of BI software implementation. We propose that the absorptive capacity and sophisticated IT infrastructure are the key drivers of organizations' assimilation of BI into their business strategies and value-chain activities. The results of the study have broad implications for both theory and practice.

With regards to theory, the result provides empirical support for organizational learning theory in relation to the assimilation of advanced MCS (Attewell 1992; Fichman and Kemerer 1997). The study identifies two organizational-learning related factors, *operational-level absorptive capacity* and *TMT's absorptive capacity* that should have an influence on the assimilation of a broad range of strategic information systems. We find that the operational-level absorptive capacity has significant influence on BI assimilation. TMT's absorptive capacity is found to have significant influence on operational-level absorptive capacity. The result also demonstrates that TMT's absorptive capacity has an indirect influence on BI assimilation, and that operational-level absorptive capacity fully mediates the relation. These results are consistent with the findings in prior technology assimilation studies, particularly, Boynton et. al. (1994), and Fichman and Kemerer (1997), which found the level of knowledge of both line and IT managers to be significantly related to IT assimilation. However, those studies focus on static levels of knowledge while this study adopts the dynamic view of knowledge in terms of knowledge creation. The results reported in this study, in relation to the indirect impact of TMT's absorptive capacity on BI, are a valuable extension to prior assimilation studies. For instance, Armstrong and Sambamurthy (1999) reported that TMT strategic IT knowledge had no direct influence on assimilation. When linked to this study, it clearly indicates that TMT's knowledge is best conceptualized as having an indirect effect on assimilation. Future research should further explore this indirect effect in order to better understand the mechanisms through which TMT's knowledge is converted into valuable resources that have immediate effect on systems assimilation. Moreover, focusing on absorptive capacity is more comprehensive and relevant than managerial IT knowledge constructs used in prior assimilation studies. Absorptive capacity captures the ability of the organization to create and apply knowledge in different

courses of actions, which is superior to the static view of knowledge adopted in prior assimilation studies.

Furthermore, this research found that operational-level absorptive capacity has a significant influence on IT infrastructure sophistication while TMT's absorptive capacity has no direct effect. Post hoc tests reveal there is an indirect relation between TMT's absorptive capacity and IT infrastructure with operational-level managers' absorptive capacity fully mediating the relation. These findings demonstrate that sophisticated IT infrastructure is developed through socially complex processes which involve collaborations between TMT, IT specialists and operations level managers. Moreover, the results also support the calls made in both the accounting and IS research for management accountants, line managers and IT managers to develop broader knowledge, interpersonal skills, and deeper understanding of the strategic content of the organization (Todd et. al. 1995; Nelson and Coopriider 1996; Caglio 2003; Bryd et. al. 2004; Dechow and Mouritsen 2005; Quattrone and Hopper 2005; Arnold 2006; Rikhardsson and Kraemmergard 2006).

The study also found that sophisticated IT infrastructure has a significant influence on BI assimilation. This result provides empirical support for real options theory which conceptualizes IT infrastructure as growth options investments to support future systems applications (Bowman and Hurry 1993; Dai et. al. 2005). As the results demonstrate, organizations which have diffused the base foundation of IT capability, through investment in generic and specialized platforms, were able to assimilate BI software, more effectively than their competitors.

In weighing the results of the study, there are several inherent limitations that should be considered. First, although an attempt was made in this study to solicit multiple respondents from each of the targeted firms, only a single contact was available for many of the firms.

However, tests show there is no difference between the mean responses received from single respondents versus those from multiple respondents. Second, using the same informants to answer questions on both operational and strategic-level constructs may create a respondent's bias or knowledge bias. However, techniques used in the study help to alleviate some of that concern. These include providing respondents with a "No Basis for Answering" option in the survey, capturing the same data from multiple respondents, testing for consistency between multiple respondents, testing for common method variance, and testing for discriminant validity. All tests suggest that such concern does not threaten the validity of the results. Still future studies may consider using two separate surveys. One would be answered by TMT members and include questions on the TMT characteristics, and the other by middle/operational level managers and include questions on BI assimilation, IT infrastructure, etc. Third, the study investigated only a few of the organizational factors that relate to organizational knowledge, IT resources, and TMT that influence BI assimilation. Other factors relating to competitive environment and governance may influence BI assimilation. This is an area for future research.

This research has significant practical implication for management accountants, organizational management, managers using MCS, IT consultants, and technology vendors. The clearest message is that successful assimilation of MCS is not achieved by acquiring "state of the art" MCS software, but through developing the appropriate organizational capability of generating and using new knowledge to support MCS. The findings in this study re-enforce organizations' continuous effort in knowledge creation activities at both the TMT and operational level. Organizations should promote knowledge creation activities as an ongoing process rather than purposeful and directed short-term knowledge acquisition sessions such as training programs. Moreover, organizations need to develop high quality IT infrastructure to

support future MCS investment.

This study makes two significant contributions to the overall strategic information systems assimilation literature: First, it investigated the significance of an important characteristic of the TMT (absorptive capacity) in assimilation. In addition to the simple main effect which was suggested in prior assimilation literature, this study identifies the roles of TMT leadership in shaping the organizational resources (IT infrastructure and absorptive capacity) that are necessary precursors for assimilation. *Second*, the study draws on the dynamic view of organizational knowledge which has been advocated in the contemporary knowledge management literature (Nonaka 1994; Cook and Brown 1999). In that regard, strategic systems assimilation can be better understood as a process in which the organization creates and defines problems and then actively develops new ways to solve them. The insignificance of control variables (in particular static managerial IT knowledge) on assimilation is a clear indication of the superiority of the dynamic perspective of organizational knowledge over the static perspective used in prior IT assimilation studies.

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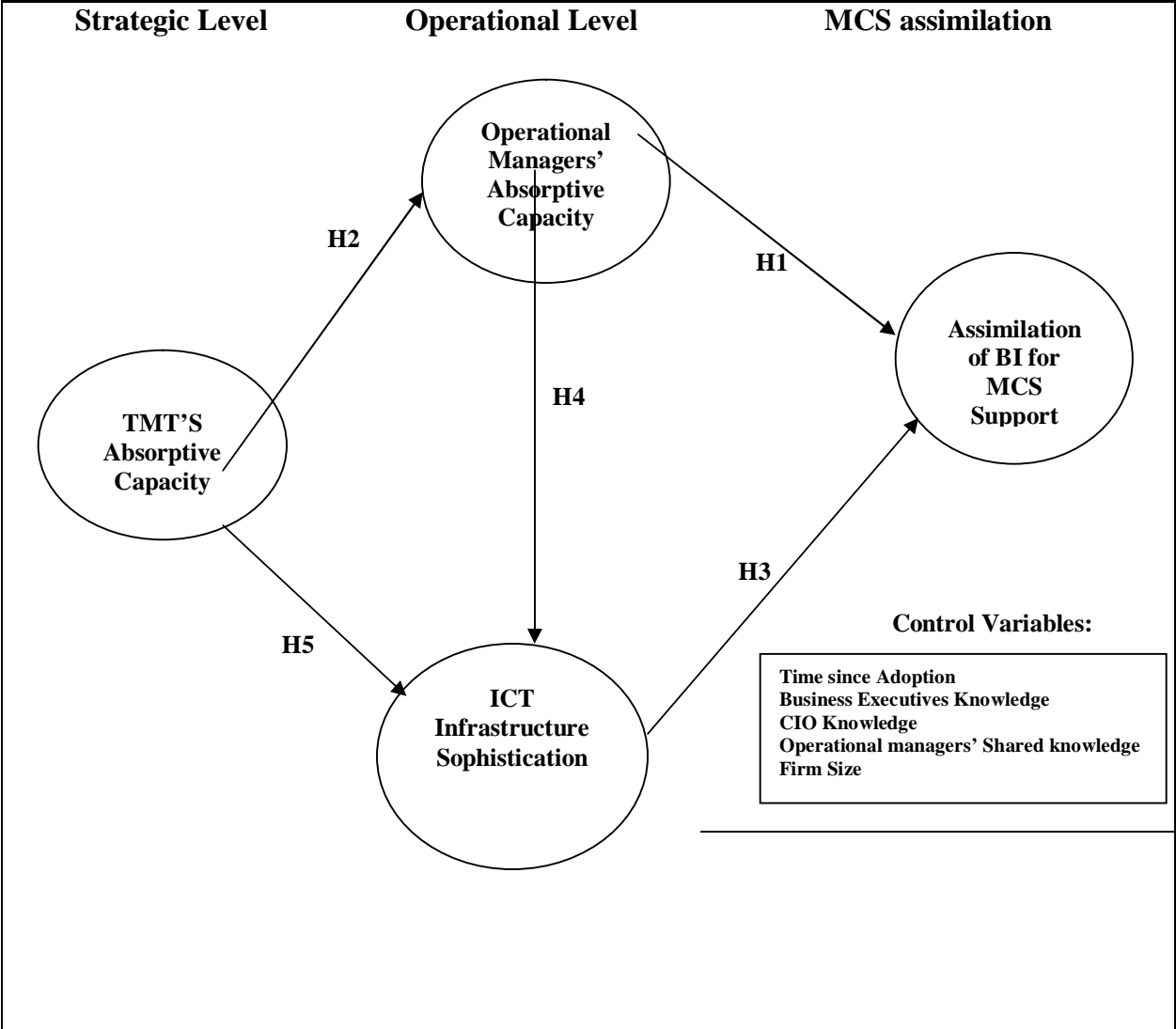
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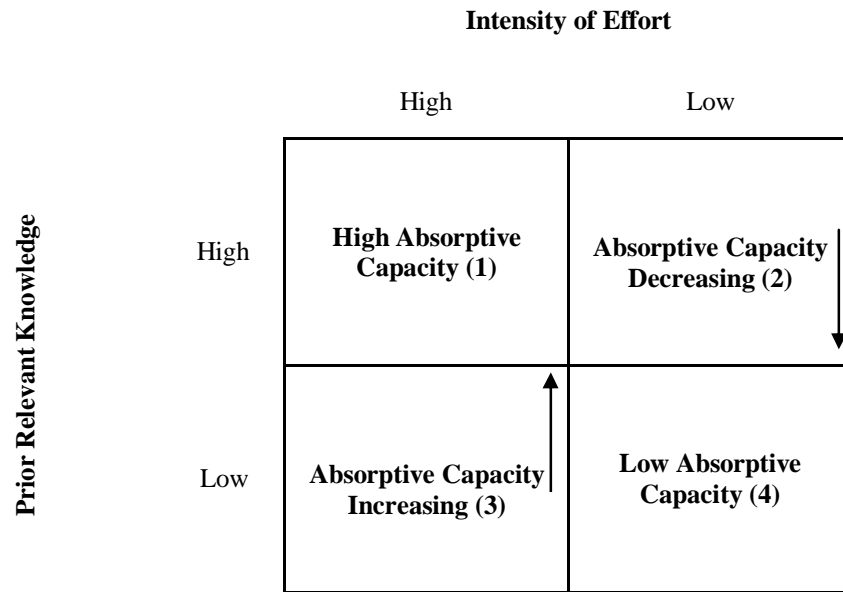
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**Figure 1: BI Assimilation Model**



**Figure 2:** Two Elements of Absorptive Capacity: Kim (1995, p. 268).

**Table 1 Distribution of industries represented in the sample**

<b>Industry Categories</b>	<b>Frequency</b>	<b>Percentage</b>
Banking/finance/insurance	43	12.4%
Manufacturing	65	18.7%
Health care	35	10.1%
Retail/wholesales/distribution	50	14.4%
Media/entertainment/publishing	11	3.2%
Telecommunications	21	6.1%
Transport/Logistics	12	3.5%
Agricultural/mining/construction	12	3.5%
Consulting/professional service	34	9.8%
Hospitality/travel/tourism	6	1.7%
<i>Others</i>	36	10.4%
<i>Missing (did not specify industry)</i>	22	6.3%

**Table 2:** Individual item loadings, composite reliability, average variance extracted (AVE) statistics.

<b>Assimilation - Customer Relation:</b> (Composite Reliability = 0.90, AV E = 0.61)			
	<b>Loading</b>	<b>Standard Error</b>	<b>T-Statistics</b>
<b>ASA1:</b> Customer services (e.g. improving customer satisfaction).	0.77	0.03	28.43
<b>ASA2:</b> Delivery of products/services.	0.76	0.03	26.78
<b>AST3:</b> Enhancing customer relations.	0.75	0.03	24.10
<b>AST5:</b> Enhancing existing products/services.	0.80	0.02	32.49
<b>AST6:</b> Providing value-added goods/services to customers.	0.85	0.02	52.89
<b>AST7:</b> Creating new products/services.	0.74	0.03	28.67
<b>Assimilation - Business Operations</b> (Composite Reliability = 0.86, AV E = 0.61)			
<b>ASA5:</b> Supplier management (e.g. inbound logistics or purchasing).	0.78	0.02	36.93
<b>ASA7:</b> Manufacturing and/or internal operations.	0.78	0.03	26.25
<b>AST1:</b> Being a low-cost producer/provider.	0.73	0.04	17.62
<b>AST2:</b> Creating flexible manufacturing/operations processes.	0.81	0.02	33.64
<b>Assimilation - Marketing and Sales</b> (Composite Reliability = 0.87, AV E = 0.68)			
<b>ASA3:</b> Marketing (e.g. targeting customers and tailoring offers).	0.84	0.02	35.55
<b>ASA4:</b> Sales (e.g. sales force automation, revenue management).	0.84	0.02	40.54
<b>AST8:</b> Entering new markets.	0.80	0.02	34.12
<b>Operational Absorptive capacity - Internalisation:</b> (Composite Reliability = 0.92, AV E = 0.62)			
<b>KCO19</b> Experiment with new ideas to improve their own...	0.78	0.03	30.36
<b>KCO20</b> Engage in face-to-face meetings where new ideas...	0.83	0.02	35.17
<b>KCO21</b> Encourage teamwork and communication between...	0.84	0.02	43.03
<b>KCO22</b> Engage in business-related activities with cross-...	0.77	0.03	26.98
<b>KCO23</b> Use on-the-job training to improve their own...	0.75	0.03	24.55
<b>KCO24</b> Search for new ideas...	0.82	0.02	36.99
<b>KCO25</b> Create a work environment that is supportive...	0.72	0.04	18.92

**Table 2 Continued**

<b>Operational Absorptive capacity - Socialization:</b> (Composite Reliability = 0.86, AV E = 0.51)			
<b>KCO1</b> Use mentoring/apprenticeship techniques to share...	0.68	0.04	17.96
<b>KCO2</b> Rotate across different areas/departments of the...	0.63	0.04	16.96
<b>KCO3</b> Engage in cooperative projects across departments...	0.71	0.03	25.08
<b>KCO4</b> Engage in informal communication networks with...	0.73	0.03	24.94
<b>KCO6</b> Share information/ideas/experiences with suppliers...	0.78	0.03	30.78
<b>KCO7</b> Share information/ideas/experiences with external...	0.72	0.03	22.53
<b>Operational Absorptive capacity - Combination</b> (Composite Reliability = 0.89, AV E = 0.61)			
<b>KCO14</b> Summarize and document information collected...	0.76	0.03	28.93
<b>KCO15</b> Make information collected from different sources...	0.80	0.03	31.02
<b>KCO16</b> Use databases to store relevant information to share..	0.81	0.02	36.60
<b>KCO17</b> Use information technologies to build information...	0.78	0.03	26.11
<b>KCO18</b> Gather and systematize organization's business...	0.76	0.03	25.38
<b>Operational Absorptive capacity - Externalisation</b> (Composite Reliability = 0.86, AV E = 0.60)			
<b>KCO10</b> Tell stories as a way of sharing their knowledge...	0.79	0.03	28.57
<b>KCO11</b> Use pointers to expertise (e.g. skills directory...	0.73	0.03	23.57
<b>KCO12</b> Use analogies and metaphors as a way of sharing...	0.84	0.02	46.52
<b>KCO13</b> Use brainstorming retreats or camps to generate...	0.74	0.03	27.22
<b>TMT's Absorptive capacity - Internalisation:</b> (Composite Reliability = 0.91, AV E = 0.66)			
<b>KCS22</b> Experiment with new management practices to ...	0.81	0.02	37.49
<b>KCS23</b> Are keen to understand different groups' visions...	0.85	0.02	51.95
<b>KCS24</b> Read business/IT publications.	0.73	0.04	19.45
<b>KCS25</b> Use "learning by involvement" in different projects...	0.87	0.02	52.61
<b>KCS26</b> Foster a work environment that is supportive of...	0.80	0.03	30.84

**Table 2 Continued**

<b>TMT's Absorptive capacity - Externalisation:</b> (Composite Reliability = 0.91, AV E = 0.66)			
<b>KCS4</b> Develop new strategies/business opportunities by...	0.81	0.02	39.03
<b>KCS5</b> Make regular contacts with each other through...	0.73	0.03	23.17
<b>KCS7</b> Share information/ideas/experiences with...	0.85	0.02	46.82
<b>KCS8</b> Demonstrate and model their expertise to other...	0.86	0.02	45.43
<b>KCS12</b> Engage in dialogue with subordinates to exchange...	0.81	0.02	39.22
<b>TMT's Absorptive capacity - Combination:</b> (Composite Reliability = 0.91, AV E = 0.66)			
<b>KCS15</b> Plan strategies by using computer simulation and...	0.75	0.03	27.23
<b>KCS16</b> Gather and summarize information from different...	0.84	0.02	44.58
<b>KCS17</b> Build databases on products/services by gathering...	0.80	0.02	32.71
<b>KCS18</b> Convene meetings where new concepts and...	0.82	0.02	39.36
<b>KCS19</b> Use information technologies to collect/transmit...	0.84	0.02	46.01
<b>TMT's Absorptive capacity -Socialization:</b> (Composite Reliability = 0.86, AV E = 0.60)			
<b>KCS1</b> Share ideas/experiences with clients and suppliers.	0.83	0.02	39.13
<b>KCS2</b> Share ideas/experiences with external experts.	0.79	0.03	24.23
<b>KCS3</b> Gather information/ideas from competitors.	0.75	0.03	22.94
<b>KCS13</b> Converse with competitors to gather information...	0.74	0.03	24.34
<b>Generic IT:</b> (Composite Reliability =0.87, AV E = 0.58)			
<b>CT1</b> Mainframe/server systems.	0.61	0.05	12.80
<b>ICT7</b> Internal computer network.	0.72	0.04	17.28
<b>ICT8</b> IT architecture and standards. ...	0.79	0.02	32.08
<b>ICT9</b> Security and risk management policies...	0.87	0.01	60.13
<b>ICT10</b> The latest back end technology....	0.77	0.03	28.65

**Table 2 Continued**

<b>Specialised IT:</b> (Composite Reliability = 0.88, AV E = 0.64)			
<b>ICT3</b> Data warehouses/data marts.	0.87	0.02	51.21
<b>ICT4</b> Extract, Transform, Load (ETL) and/other tools to import...	0.88	0.02	56.04
<b>ICT5</b> Analytical/reporting tools such as data mining and OLAP...	0.78	0.03	24.92
<b>ICT6</b> Technologies that enable electronic access to external...	0.65	0.05	14.10
<b>CIO Knowledge:</b> (Composite Reliability = 0.92, AV E = 0.63)			
<b>CIOK1</b> The IT infrastructure required to support...	0.70	0.11	6.65
<b>CIOK2</b> The potential and limitations of relevant...	0.71	0.10	7.04
<b>CIOK3</b> How competitors are using business intelligence...	0.80	0.05	15.81
<b>CIOK4</b> Timing and investment strategies in emerging....	0.83	0.06	13.47
<b>CIOK5</b> The organization's present and future products...	0.79	0.04	18.10
<b>CIOK6</b> What is considered best practice in the organization...	0.86	0.04	21.41
<b>CIOK7</b> The business activities of the organization's competitors.	0.84	0.05	17.99
<b>Business Executives Knowledge:</b> (Composite Reliability = 0.92, AV E = 0.80)			
<b>BEK1</b> The potential and limitations of the organization's...	0.86	0.03	31.50
<b>BEK2</b> The potential and limitations of emerging information...	0.91	0.02	47.00
<b>BEK3</b> How competitors are applying information technologies.	0.90	0.02	46.16
<b>Operational Managers' shared Knowledge:</b> (Composite Reliability = 0.94, AV E = 0.75)			
<b>Shared1</b> Line managers understand the work environment (problems, tasks, roles, etc.) of the information systems managers	.80	0.03	30.00
<b>Shared2</b> Information systems managers understand the work environment (problems, tasks, roles, etc.) of the line managers	0.81	0.03	29.46
<b>Shared3</b> Line managers appreciate the accomplishments of the information systems managers	0.89	0.02	51.43
<b>Shared4</b> Information systems managers appreciate the accomplishments of the line managers	0.88	0.02	49.48
<b>Shared5</b> Information systems managers and line managers appreciate each others' accomplishments	0.93	0.01	82.53

**Table 2 Continued**

<b>Firm Size: (Composite Reliability = 0.79, AVE = 0.66)</b>			
<b>Employees</b>	0.82	0.29	3.46
<b>Revenue</b>	0.70	0.29	2.03

**Table 3: Inter-Construct Correlations and Square Root of Average Variance Extracted Statistics <sup>a</sup> (n = 347)**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
(1) Assimilation (Customer Relation)	<b>0.80</b>																	
(2) Assimilation (Operation)	0.56	<b>0.78</b>																
(3) Assimilation (Marketing)	0.64	0.38	<b>0.83</b>															
(4) Internalisation (Operational)	0.23	0.27	0.28	<b>0.79</b>														
(5) Socialisation (Operational)	0.35	0.38	0.24	0.61	<b>0.71</b>													
(6) Combination (Operational)	0.32	0.37	0.29	0.62	0.54	<b>0.78</b>												
(7) Externalisation (Operational)	0.38	0.38	0.33	0.54	0.56	0.57	<b>0.78</b>											
(8) Internalisation (TMT)	0.17	0.16	0.18	0.59	0.44	0.45	0.44	<b>0.81</b>										
(9) Externalisation (TMT)	0.21	0.22	0.21	0.60	0.44	0.41	0.36	0.72	<b>0.81</b>									
(10) Combination (TMT)	0.31	0.28	0.38	0.56	0.44	0.55	0.45	0.68	0.68	<b>0.88</b>								
(11) Socialisation (TMT)	0.24	0.23	0.23	0.47	0.51	0.35	0.41	0.53	0.60	0.54	<b>0.78</b>							
(12) IT Infrastructure (Generic)	0.15	0.18	0.09	0.33	0.33	0.32	0.25	0.15	0.25	0.21	0.21	<b>0.76</b>						
(13) IT Infrastructure (Specialized)	0.42	0.28	0.29	0.22	0.27	0.33	0.32	0.16	0.15	0.30	0.21	0.45	<b>0.80</b>					
(14) ShareKnowled	0.25	0.22	0.29	0.50	0.43	0.41	0.34	0.47	0.52	0.48	0.35	0.26	0.16	<b>0.87</b>				
(15) Time since adoption	0.08	0.15	0.17	0.08	0.17	0.13	0.15	0.02	0.06	0.07	0.07	0.12	0.10	-0.02	<b>1.00</b>			
(16)CIO Knowledge	0.16	0.12	0.15	0.42	0.26	0.29	0.21	0.47	0.47	0.46	0.33	0.26	0.14	0.47	0.03	<b>0.79</b>		
(17) TMT Knowledge	0.24	0.18	0.18	0.42	0.35	0.33	0.37	0.58	0.48	0.48	0.37	0.10	0.09	0.46	0.06	0.56	<b>0.89</b>	
(18) Firm Size	-0.08	0.00	-0.06	-0.14	-0.07	-0.07	0.00	-0.16	-0.17	-0.10	-0.06	0.14	0.17	-0.19	0.14	-0.11	-0.16	<b>0.81</b>

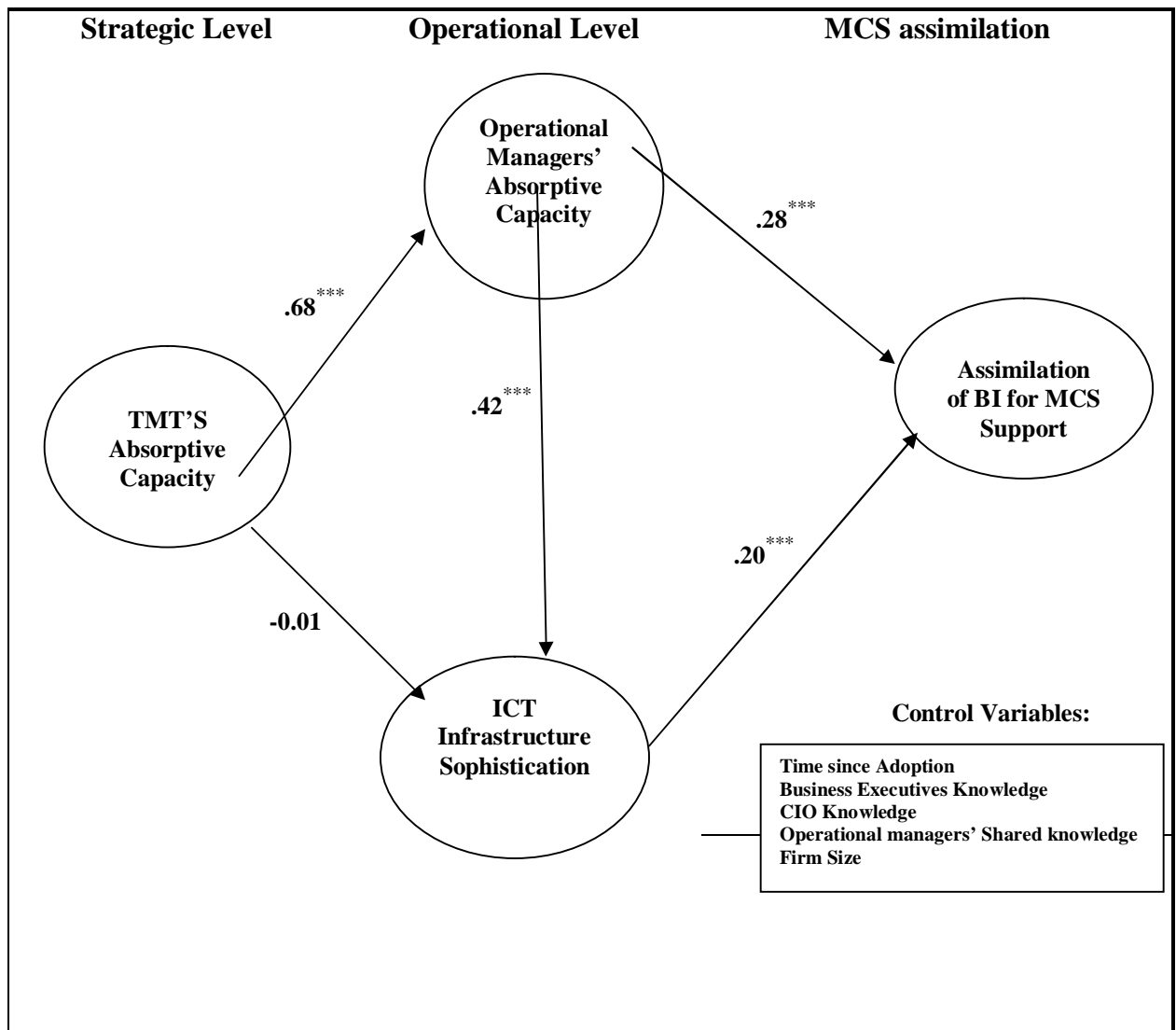
<sup>a</sup> Diagonal elements are the square roots of the average variance extracted statistics. Off-diagonal elements are the correlations between the latent variables calculated in PLS.

**Table 4: Items Loading and Cross Loading**

Items	BI Assimilation			Absorptive Capacity-Operational				Absorptive Capacity-TMT				IT Infrastructure Sophistication		Share. Know.	CIO Know.	TMT Know.	Frm Size	Time Since Adopt.
	Custom Assim	Busin. Assim	Market. Assim	OpAbs Internal.	OpAbs. Social.	OpAbs Combi.	OpAbs Extern.	TMTAbs Intern	TMTAbs Extern.	TMT COMBI NATION	TMTAbs Social.	ITSoph Gener.	ITSoph Specia.	Share. Know.	CIO Know.	TMT Know.	Frm Size	Time Since Adopt.
asa1	0.61	0.32	0.35	0.12	0.18	0.15	0.20	0.07	0.12	0.12	0.12	0.12	0.23	0.12	0.11	0.12	-0.04	0.06
asa2	0.58	0.37	0.27	0.06	0.15	0.12	0.18	0.07	0.11	0.16	0.10	0.09	0.25	0.07	0.09	0.14	-0.06	0.10
ast3	0.58	0.31	0.42	0.15	0.17	0.18	0.17	0.11	0.12	0.15	0.16	0.07	0.27	0.14	0.10	0.09	-0.08	0.06
ast5	0.63	0.26	0.40	0.13	0.19	0.15	0.19	0.10	0.12	0.23	0.15	0.08	0.28	0.12	0.06	0.13	-0.03	0.05
ast6	0.68	0.28	0.39	0.20	0.24	0.24	0.25	0.19	0.19	0.24	0.19	0.08	0.31	0.21	0.14	0.15	-0.12	0.05
ast7	0.55	0.27	0.44	0.17	0.23	0.17	0.24	0.14	0.13	0.22	0.14	0.10	0.18	0.16	0.11	0.20	-0.01	0.05
asa5	0.34	0.61	0.21	0.14	0.24	0.18	0.23	0.12	0.11	0.15	0.13	0.10	0.12	0.10	0.05	0.14	-0.02	0.11
asa7	0.25	0.60	0.22	0.14	0.17	0.17	0.20	0.05	0.08	0.12	0.05	0.11	0.09	0.13	0.04	0.10	-0.02	0.10
ast1	0.24	0.55	0.15	0.14	0.22	0.22	0.21	0.09	0.16	0.20	0.13	0.18	0.20	0.15	0.12	0.09	0.07	0.09
ast2	0.33	0.62	0.28	0.15	0.20	0.19	0.19	0.12	0.12	0.18	0.16	0.08	0.19	0.15	0.11	0.11	-0.01	0.06
asa3	0.38	0.18	0.65	0.13	0.11	0.15	0.16	0.08	0.10	0.20	0.12	0.05	0.21	0.12	0.07	0.05	-0.04	0.12
asa4	0.35	0.22	0.63	0.18	0.14	0.15	0.16	0.11	0.16	0.23	0.13	0.06	0.22	0.18	0.10	0.08	-0.07	0.07
ast8	0.40	0.26	0.65	0.24	0.20	0.17	0.24	0.17	0.18	0.26	0.20	0.10	0.13	0.23	0.14	0.16	-0.10	0.12
kco19	0.17	0.15	0.22	0.61	0.36	0.40	0.30	0.35	0.28	0.35	0.29	0.15	0.16	0.34	0.21	0.23	-0.11	0.01
kco20	0.19	0.18	0.22	0.67	0.33	0.37	0.34	0.37	0.36	0.37	0.30	0.20	0.20	0.27	0.25	0.21	-0.10	0.06
kco21	0.16	0.18	0.22	0.70	0.38	0.39	0.36	0.41	0.44	0.40	0.29	0.25	0.16	0.35	0.31	0.30	-0.04	0.05
kco22	0.11	0.13	0.15	0.60	0.34	0.35	0.34	0.34	0.35	0.35	0.26	0.23	0.15	0.27	0.24	0.22	-0.02	0.13
kco23	0.13	0.16	0.14	0.56	0.34	0.31	0.22	0.30	0.32	0.28	0.28	0.28	0.16	0.25	0.20	0.16	-0.08	0.02
kco24	0.12	0.09	0.18	0.66	0.35	0.27	0.28	0.36	0.36	0.30	0.29	0.25	0.14	0.32	0.26	0.24	-0.08	0.02
kco25	0.04	0.05	0.09	0.56	0.34	0.31	0.25	0.41	0.33	0.29	0.28	0.10	0.06	0.34	0.25	0.24	-0.11	0.03
kco1	0.17	0.17	0.09	0.28	0.51	0.28	0.25	0.24	0.21	0.21	0.21	0.16	0.16	0.23	0.10	0.20	-0.01	0.12
kco2	0.15	0.17	0.07	0.20	0.47	0.21	0.26	0.16	0.11	0.14	0.18	0.09	0.11	0.10	0.09	0.12	0.03	0.09
kco3	0.20	0.22	0.20	0.37	0.57	0.34	0.31	0.24	0.25	0.32	0.21	0.24	0.16	0.32	0.18	0.18	-0.04	0.13
kco4	0.17	0.19	0.14	0.36	0.56	0.29	0.31	0.27	0.29	0.28	0.28	0.16	0.08	0.23	0.16	0.21	-0.06	0.12
kco6	0.23	0.20	0.16	0.31	0.59	0.24	0.28	0.22	0.24	0.22	0.31	0.13	0.14	0.24	0.16	0.20	-0.07	0.07
kco7	0.22	0.18	0.20	0.31	0.55	0.27	0.31	0.23	0.20	0.25	0.34	0.25	0.21	0.25	0.19	0.16	0.00	0.08

	BI Assimilation			Absorptive Capacity-Operational				Absorptive Capacity-TMT				IT Infrastructure Sophistication		Share. Know.	CIO Know.	TMT Know.	Frm Size	Time Since Adopt.
Items	Custom Assim	Busin. Assim	Market. Assim	OpAbs Internal.	OpAbs. Social.	OpAbs Combi.	OpAbs Extern.	TMTAbs Intern	TMTAbs Extern.	TMT COMBI NATION	TMTAbs Social.	ITSoph Gener.	ITSoph Specia.	Share. Know.	CIO Know.	TMT Know.	Frm Size	Time Since Adopt.
kco14	0.21	0.20	0.18	0.38	0.34	<b>0.63</b>	0.40	0.33	0.27	0.37	0.18	0.16	0.22	0.28	0.20	0.20	-0.03	0.08
kco15	0.14	0.17	0.11	0.33	0.30	<b>0.62</b>	0.33	0.23	0.20	0.31	0.20	0.19	0.22	0.23	0.14	0.15	0.05	0.07
kco16	0.20	0.21	0.21	0.31	0.28	<b>0.61</b>	0.31	0.17	0.20	0.30	0.18	0.15	0.23	0.21	0.14	0.15	-0.06	0.08
kco17	0.18	0.18	0.18	0.32	0.32	<b>0.60</b>	0.24	0.21	0.24	0.32	0.18	0.23	0.22	0.26	0.16	0.18	-0.05	0.05
kco18	0.13	0.20	0.14	0.37	0.26	<b>0.61</b>	0.32	0.26	0.25	0.35	0.18	0.16	0.10	0.25	0.19	0.22	-0.05	0.02
kco10	0.17	0.16	0.17	0.31	0.37	0.29	<b>0.64</b>	0.24	0.21	0.25	0.26	0.14	0.21	0.19	0.10	0.16	-0.01	0.07
kco11	0.22	0.21	0.14	0.22	0.28	0.35	<b>0.56</b>	0.18	0.11	0.22	0.14	0.13	0.23	0.18	0.12	0.19	0.02	0.06
kco12	0.21	0.27	0.23	0.31	0.32	0.32	<b>0.70</b>	0.26	0.18	0.27	0.25	0.14	0.17	0.19	0.11	0.19	0.00	0.11
kco13	0.23	0.19	0.21	0.36	0.34	0.35	<b>0.56</b>	0.33	0.31	0.29	0.24	0.16	0.17	0.28	0.19	0.27	-0.01	0.11
kcs22	0.12	0.09	0.11	0.35	0.26	0.30	0.30	<b>0.64</b>	0.42	0.41	0.33	0.17	0.13	0.26	0.31	0.34	-0.09	0.01
kcs23	0.14	0.12	0.15	0.40	0.26	0.28	0.28	<b>0.70</b>	<b>0.52</b>	0.46	0.36	0.17	0.12	0.39	0.33	0.38	-0.05	0.03
kcs24	0.11	0.06	0.05	0.26	0.21	0.21	0.18	<b>0.55</b>	0.32	0.35	0.33	0.12	0.08	0.22	0.25	0.31	-0.07	0.00
kcs25	0.15	0.14	0.15	0.39	0.32	0.31	0.27	<b>0.70</b>	0.46	0.45	0.32	0.09	0.11	0.31	0.26	0.34	-0.11	0.02
kcs26	0.09	0.07	0.14	0.43	0.31	0.29	0.27	<b>0.64</b>	0.45	0.40	0.32	0.02	0.08	0.34	0.25	0.30	-0.13	-0.02
kcs4	0.15	0.18	0.12	0.33	0.26	0.25	0.21	0.41	<b>0.62</b>	0.39	0.43	0.19	0.09	0.36	0.28	0.30	-0.13	-0.03
kcs5	0.07	0.05	0.15	0.31	0.23	0.18	0.14	0.31	<b>0.59</b>	0.36	0.38	0.22	0.09	0.26	0.23	0.18	-0.10	0.07
kcs7	0.17	0.15	0.17	0.34	0.25	0.23	0.18	0.42	<b>0.71</b>	0.40	0.35	0.19	0.12	0.33	0.30	0.30	-0.12	0.01
kcs8	0.17	0.16	0.18	0.41	0.26	0.29	0.25	0.49	<b>0.73</b>	0.48	0.38	0.15	0.16	0.35	0.31	0.32	-0.12	0.02
kcs12	0.11	0.11	0.14	0.40	0.28	0.29	0.28	<b>0.50</b>	<b>0.65</b>	0.47	0.37	0.13	0.10	0.34	0.31	0.32	-0.08	0.05
kcs15	0.20	0.16	0.23	0.28	0.25	0.29	0.23	0.34	0.35	<b>0.58</b>	0.26	0.11	0.17	0.28	0.29	0.30	-0.05	0.07
kcs16	0.21	0.13	0.25	0.36	0.30	0.35	0.28	0.41	0.47	<b>0.68</b>	0.38	0.18	0.19	0.34	0.30	0.28	-0.06	0.03
kcs17	0.18	0.13	0.22	0.28	0.25	0.38	0.27	0.36	0.33	<b>0.63</b>	0.27	0.08	0.20	0.23	0.24	0.24	-0.04	0.00
kcs18	0.13	0.15	0.17	0.44	0.30	0.32	0.26	0.47	0.52	<b>0.66</b>	0.37	0.18	0.15	0.32	0.30	0.28	-0.10	0.01
kcs19	0.19	0.21	0.25	0.37	0.29	0.36	0.33	0.46	0.40	<b>0.68</b>	0.29	0.12	0.20	0.33	0.27	0.34	-0.08	0.04
kcs1	0.15	0.14	0.11	0.29	0.35	0.25	0.25	0.37	0.36	0.35	<b>0.64</b>	0.10	0.12	0.27	0.18	0.21	-0.09	0.05
kcs2	0.13	0.14	0.14	0.27	0.25	0.20	0.21	0.28	0.30	0.32	<b>0.61</b>	0.15	0.15	0.23	0.22	0.15	0.00	0.04
kcs3	0.15	0.08	0.23	0.30	0.25	0.19	0.21	0.28	0.42	0.33	<b>0.61</b>	0.15	0.11	0.19	0.19	0.22	-0.09	0.07
kcs13	0.15	0.10	0.15	0.25	0.27	0.17	0.24	0.31	0.38	0.28	<b>0.60</b>	0.10	0.12	0.20	0.23	0.26	-0.03	0.05

	BI Assimilation			Absorptive Capacity-Operational				Absorptive Capacity-TMT				IT Infrastructure Sophistication		Share. Know.	CIO Know.	TMT Know.	Frm Size	Time Since Adopt.
Items	Custom Assim	Busin. Assim	Market. Assim	OpAbs Internal.	OpAbs. Social.	OpAbs Combi.	OpAbs Extern.	TMTAbs Intern	TMTAbs Extern.	TMT COMBINATION	TMTAbs Social.	ITSoph Gener.	ITSoph Specia.	Share. Know.	CIO Know.	TMT Know.	Frm Size	Time Since Adopt.
ict1	0.04	0.15	0.06	0.09	0.11	0.06	0.05	0.01	0.09	0.01	0.06	0.51	0.14	0.10	0.11	0.01	0.03	0.10
ict7	0.08	0.06	0.10	0.21	0.16	0.12	0.08	0.12	0.16	0.12	0.09	0.56	0.15	0.10	0.11	-0.01	0.08	0.04
ict8	0.10	0.10	0.11	0.24	0.21	0.24	0.21	0.14	0.15	0.16	0.13	0.63	0.27	0.18	0.14	0.05	0.12	0.11
ict9	0.06	0.13	0.06	0.28	0.23	0.22	0.17	0.15	0.20	0.20	0.14	0.72	0.26	0.18	0.20	0.10	0.04	0.11
ict10	0.15	0.10	0.10	0.20	0.21	0.20	0.18	0.11	0.17	0.16	0.11	0.61	0.32	0.22	0.22	0.11	0.06	0.03
ict3	0.28	0.17	0.20	0.19	0.19	0.25	0.19	0.12	0.16	0.22	0.14	0.26	0.74	0.10	0.10	0.09	0.05	0.09
ict4	0.26	0.14	0.17	0.14	0.18	0.23	0.20	0.11	0.12	0.19	0.14	0.26	0.74	0.11	0.11	0.10	0.07	0.09
ict5	0.30	0.13	0.28	0.17	0.16	0.19	0.21	0.13	0.12	0.22	0.13	0.20	0.62	0.13	0.07	0.06	0.02	0.05
ict6	0.21	0.20	0.18	0.11	0.14	0.15	0.19	0.05	0.05	0.14	0.10	0.33	0.52	0.11	0.12	0.02	0.05	0.06
shared1	0.12	0.09	0.19	0.36	0.29	0.28	0.27	0.33	0.31	0.31	0.24	0.16	0.13	0.64	0.27	0.34	-0.10	0.05
shared2	0.14	0.16	0.22	0.33	0.22	0.24	0.19	0.26	0.30	0.26	0.17	0.23	0.12	0.65	0.28	0.20	-0.11	0.00
shared3	0.18	0.15	0.19	0.35	0.33	0.29	0.24	0.37	0.37	0.35	0.26	0.18	0.11	0.77	0.29	0.34	-0.12	-0.01
shared4	0.13	0.15	0.19	0.30	0.26	0.25	0.20	0.30	0.36	0.32	0.24	0.20	0.08	0.74	0.33	0.26	-0.11	-0.04
shared5	0.17	0.16	0.19	0.37	0.31	0.32	0.24	0.38	0.39	0.36	0.27	0.21	0.12	0.83	0.34	0.34	-0.13	-0.03
ciok1	0.02	0.04	0.10	0.22	0.11	0.15	0.03	0.24	0.26	0.24	0.13	0.18	0.04	0.25	0.55	0.26	-0.09	-0.01
ciok2	0.01	0.03	0.04	0.21	0.09	0.12	0.08	0.22	0.24	0.21	0.14	0.18	0.06	0.26	0.57	0.28	-0.10	-0.04
ciok3	0.11	0.05	0.09	0.25	0.20	0.19	0.16	0.30	0.27	0.29	0.25	0.15	0.08	0.27	0.68	0.39	-0.08	-0.02
ciok4	0.11	0.07	0.04	0.26	0.17	0.18	0.13	0.32	0.26	0.30	0.20	0.20	0.10	0.29	0.69	0.39	-0.03	-0.02
ciok5	0.06	0.04	0.15	0.33	0.16	0.19	0.14	0.29	0.35	0.30	0.21	0.19	0.11	0.33	0.60	0.27	-0.09	0.00
ciok6	0.10	0.11	0.12	0.29	0.18	0.22	0.12	0.32	0.33	0.33	0.20	0.22	0.11	0.36	0.70	0.36	-0.05	0.01
ciok7	0.13	0.10	0.13	0.24	0.18	0.14	0.17	0.26	0.26	0.27	0.22	0.11	0.12	0.25	0.68	0.31	-0.02	0.06
bek1	0.12	0.10	0.12	0.25	0.19	0.22	0.21	0.39	0.31	0.32	0.22	0.10	0.05	0.29	0.37	0.69	-0.10	0.06
bek2	0.12	0.13	0.11	0.28	0.21	0.25	0.24	0.39	0.32	0.34	0.18	0.07	0.09	0.33	0.39	0.78	-0.10	0.03
bek3	0.22	0.13	0.12	0.26	0.27	0.19	0.26	0.36	0.30	0.31	0.29	0.09	0.08	0.30	0.37	0.81	-0.05	0.04
SizEmpl	-0.07	0.01	-0.06	-0.10	-0.02	-0.04	0.00	-0.11	-0.13	-0.08	-0.05	0.11	0.10	-0.17	-0.08	-0.13	0.86	0.13
SizRe	-0.05	0.01	0.01	-0.04	0.02	-0.05	0.00	-0.04	-0.06	-0.04	-0.01	0.07	0.11	-0.15	-0.08	-0.15	0.24	0.15
year	0.09	0.12	0.13	0.05	0.14	0.07	0.10	0.01	0.02	0.04	0.05	0.09	0.09	-0.01	0.01	0.04	0.07	1.00



**Figure 3:** The Results – BI systems Assimilation Model

**Table 5: Path Coefficients –Control Variables**

	<b>Path Coefficient</b>	<b>t value</b>
Size (No of employees). ...BI assimilation	-.05	.92
Size (Revenue) .... BI assimilation	0.07	1.19
Time since adoption of BI... BI assimilation	.09	1.85
TMT knowledge ... BI assimilation	.05	.91
CIO knowledge ... BI assimilation	-.04	.88
Operational managers' shared knowledge... BI assimilation	.07	1.14

**Table 6: Path Coefficients – Test Variables**

<b>Path/Hypotheses</b>	<b>Path Coefficient</b>	<b>t value (z score)</b>
Operational-level absorptive capacity ... Assimilation of BI systems ( <b>H1</b> )	.28	3.94***
TMT's absorptive capacity ...Operational-level absorptive capacity ( <b>H2</b> )	.68	20.52***
IT Infrastructure Sophistication .... Assimilation of BI ( <b>H3</b> )	.20	3.50**
Operational-level absorptive capacity... IT Infrastructure Sophistication ( <b>H4</b> )	.42	6.72***
TMT's absorptive capacity. ... IT Infrastructure Sophistication ( <b>H5</b> )	-.01	.08
* Indicates that the coefficient is significant at the p< .05 ** Indicates that the coefficient is significant at the p<. 01 *** Indicates that the coefficient is significant at the p<. 001		

**Table 7: Significance of the mediated paths**

Indirect Effect	Mediated Paths	Path <sup>a</sup>	z Stat
TMT's absorptive capacity to BI assimilation	TMT'S ACAP.... operational-level ACAP...BI assimilation.	.19	4.54 <sup>***</sup>
Note: a: Standardized path magnitude b =<.10, * = <.05, ** = <.01, *** = <.001			

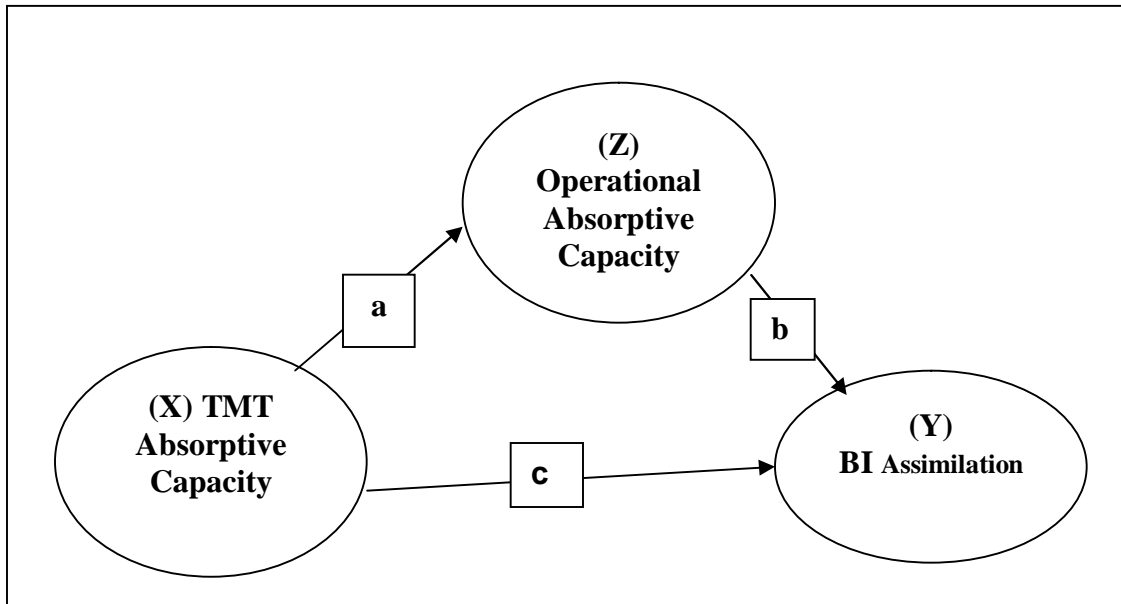
**Table 8: Nested Model Comparison**

Direct Paths	R <sup>2</sup> in Nested model (No direct Path)	R <sup>2</sup> in Models with Direct Path	F <sup>2</sup> Value	Pseudo F =F <sup>2</sup> * (n-k-1)	Conclusion
TMT's absorptive capacity to BI assimilation	.304	.304	.0007	2.41	Not Significant

## APPENDIX

### Test of Mediation:

The Path diagram presented below illustrates the direct and mediated relations tested in H2a:.



The total effect of TMT absorptive capacity (X) on BI assimilation is portioned into two components (Hoyle and Kenny 1999): the *direct effect* of X on Y (“c”) and *indirect effect* of X on Y through Z ( $a*b$ ).

The indirect effect (mediation) is the product of the effect of X on Z times the effect of Z on Y OR:  $a*b$ .

#### Two approaches were used to test the mediation hypotheses (H2a):

1/ **Analysis of the individual mediated paths** (Baron and Kenny 1986; Hoyle and Kenny 1999; Subramani 2004):

Evidence that X predicts Y

Evidence of the significance of the indirect effect of X on Y (a nonzero value for “ $a*b$ ”).

To test the significance of the indirect path (i.e.  $a*b$ ), the standard deviation of the mediated path were computed based on the magnitude and variance of the paths between X & Z (path a), and Z & Y (path b). The following equation was used to calculate the standard error of the mediated

path:  $(b^2 s_a + a^2 s_b + s_a^2 s_b^2)^{1/2}$ .

Where **a** and **b** are the paths between X & Z, and Z&Y respectively. **s<sub>a</sub>** and **s<sub>b</sub>** are standard deviation of **a** and **b** respectively. The results of the mediated path tested in this study are reported in Table 6 and 7..

## **2/ Test of the significance of the direct paths while controlling for the indirect path (Baron and Kenny 1986):**

The four steps were followed in this study to test the extent to which operational managers' absorptive capacity mediates the relation between TMT absorptive capacity and BI assimilation (Baron and Kenny 1986):

1. Test that TMT absorptive capacity predicts BI assimilation (a nonzero value for “**c**”).
2. Test that TMT absorptive capacity predicts operational managers' absorptive capacity (a nonzero value for “**a**”).
3. Test that operational managers' absorptive capacity and TMT absorptive capacity are simultaneously predict BI assimilation (a nonzero value for **b and c**).
4. Test that operational managers' absorptive capacity mediates (completely or partially) the relation between TMT absorptive capacity and BI assimilation. To establish that operational managers' absorptive capacity completely mediates the relation, the effect of IT TMT absorptive capacity on BI assimilation, controlling for operational managers' absorptive capacity (“**b**”) should be statically insignificant. If the only first three steps are met, then SIS assimilation is partially mediating the relation.

## **3/ Comparing nested models:**

The magnitude and the difference in the  $R^2$  of two models estimated through PLS was used to compare two models. The first model proposes the relation between TMT absorptive capacity and BI assimilation is completely mediated by operational managers' absorptive capacity (path c is not included in the model). The competing model proposes an extra direct path in addition to the indirect link as shown in the above figure. The  $f^2$  is assessed based on  $R^2$  difference. The significance of  $f^2$  is assessed based a pseudo F tests.  $F^2 = (R^2_{full} - R^2_{excluded}) / (1 - R^2_{full})$  (Cohen 1988; Chin et. al. 2003). The pseudo F statistic is calculated as  $f^2 * (n-k-1)$ , with 1, n-k degrees of freedom, where n is the sample size and k is the number of constructs in the model.