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# LINKING BI COMPETENCY AND ASSIMILATION THROUGH ABSORPTIVE CAPACITY: A CONCEPTUAL FRAMEWORK

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## Abstract

*Business intelligence (BI) can help support decision-making processes and so contribute to improved BI assimilation and organisational performance. However, a BI undertaking may be effective and profitable for some organisations but not others. How can these differing outcomes be explained for those firms that have adopted BI systems? Drawing on the literature pertaining to absorptive capacity theory, IT competency, and BI assimilation we develop a conceptual framework to investigate the relationships between BI competency, absorptive capacity, and BI assimilation. This research provides insights for BI stakeholders in understanding the mediating role of organisational absorptive capacity within a complex BI environment, enabling many organisations that have implemented BI to leverage the benefits from their costly investments. The conceptual framework provides a sound basis for further research to shed light on the effects of BI competency and organisational absorptive capacity on BI assimilation. Contributions to research and practice are discussed.*

*Keywords: Business intelligence competency, Business intelligence assimilation, Absorptive capacity, Conceptual framework*

# 1 INTRODUCTION

In recent years market interest in business intelligence (BI) technologies has grown markedly. Gartner's worldwide surveys of IT spending have shown that BI is the top technology priority for many chief information officers (Gartner 2013a). According to Gartner (2013b), global BI software spending exceeded US\$12 billion in 2012 and is expected to reach US\$13.8 billion in 2013. Such enthusiasm can be attributed to the recognition of the value of BI, which has been defined as "*a broad category of technologies, applications, and processes used for gathering, storing, accessing, and analysing data to help its users make better decisions*" (Wixom & Watson 2010). Moreover, BI systems are designed to support a wide variety of uses, including viewing reports and multidimensional cubes, making ad hoc queries, and executing knowledge discovery by interacting with massive amounts of data through sophisticated user interfaces such as OLAP tools (Gessner & Scott 2009). Typical expenditure on BI systems includes all BI infrastructure, packaged software, licenses, training, IT personnel, and full implementation costs, and is often measured in millions of dollars. Many organisations devote considerable financial and human resources to implementing BI systems.

Despite the increased rate of adoption of BI, many organisations face difficulty in achieving anticipated benefits. For example, Marchand and Peppard (2008) reported that one global materials-management company spent \$44 million dollars over nine years on various BI initiatives, and yet few benefits were achieved, so calling into question the overall value of the investment. Two issues which determine the usefulness of BI investments are BI competency and BI assimilation. The former refers to the extent to which an organisation is knowledgeable about, and effectively utilises, BI (Tippins & Sohi 2003). BI assimilation describes the degree to which BI has been integrated into the existing organisation and the extent to which it is used to provide strategic benefits (Elbashir et al. 2011).

While past studies have sporadically examined the role of BI within individual firms it is still not clear how BI competency contributes to improved BI assimilation. Recent literature suggests that an organisation's absorptive capacity (ACAP) plays a mediating role in enhancing a firm's capabilities, and that capacity may benefit from the judicious application of BI. It has also been argued that for firms to be successful they must complement BI competency with organisational absorptive capacity. By definition, an organisation's absorptive capacity refers to its ability to assess the value of new information, assimilate it, and apply it for commercial ends (Cadiz et al. 2009). However, to date there has been little research which clearly articulates a theoretically-grounded framework that explains the importance of an organisation's absorptive capacity to enable it to make effective use of BI. Thus the primary aim of this research is to investigate hitherto neglected relationships between organisational ACAP, BI competency, and BI assimilation. That is, this research adopts absorptive capacity theory and literature on IT competency and BI assimilation to develop a conceptual framework (so-called BI-ACAP framework) to investigate the as yet untested and complex relationships between organisational absorptive capacity, BI competency, and BI assimilation. This research therefore seeks to expand on this body of work by:

- Developing a conceptual framework linking organisational ACAP and BI competency to BI assimilation. Specifically, this research adopts absorptive capacity theory to explore how BI can be utilised to gain strategic benefits by examining the mediating role of ACAP on the linkage between BI competency and BI assimilation.
- Developing methods of measurement and operationalisation to assess BI competency, organisational ACAP, and BI assimilation. In particular, a multidimensional approach will be used to assess the three major key components of the framework, while each of the first-order factor components will be linked through a second-order factors structure.

Achieving this research objective will make a significant contribution to the existing body of knowledge on BI. This research integrates a number of fragmented insights that have been reported in the literature on both BI and absorptive capacity, and it combines those insights into a conceptual framework that will lead to better understanding of the mediating role of organisational absorptive capacity. To the best of our knowledge the proposed framework is the first account of the interplay of absorptive capacity, BI competency, and assimilation, and it thereby extends the scope of current BI literature. Moreover, this research provides a relevant response to on-going questions regarding the heterogeneous nature of BI assimilation within the wider managerial context. Specifically, we synthesise existing knowledge from prior studies on absorptive capacity, IT competency, and BI assimilation. These prior theories are identified and adapted to the context of BI. Based on the extant review of literature, we develop a conceptual framework to examine the relationships between BI competency, organisational ACAP, and BI assimilation by integrating existing theories on absorptive capacity, BI competency, and assimilation. Also, we develop a reliable and easy-to-administer instrument for measuring the extent to which BI competency and organisational ACAP relate to BI assimilation.

In the following sections we first introduce the conceptual framework for investigating the interplay of BI competency, organisational absorptive capacity, and BI assimilation. The subsequent section explains the background theories used in this study and identifies the dimensions and operational constructs for each of the three major components of the conceptual framework. Next, we discuss the contributions which this work makes to research and practice. Then follows the conclusion, and finally proposals are offered for further research initiatives.

## **2 CONCEPTUAL FRAMEWORK AND BACKGROUND THEORIES**

As shown in Figure 1, the proposed conceptual framework depicts that effective BI competency, when combined with adequate organisational absorptive capacity, strongly enhances BI assimilation. Drawing on the IT competency concept of Tippins and Sohi (2003), BI competency is a function of the degree to which BI objects are used in the organisation, the effectiveness of BI operations, and current BI knowledge in the organisation. BI competency can increase organisational absorptive capacity through two mechanisms: firstly, BI tools such as data warehouse and data mart facilitate the collection of information which enhances organisational knowledge acquisition. Secondly, the data analytics functions of BI tools support the analysis of information and help managers derive new insights. In other words, BI systems provide users with direct access to structured data, as well as to multidimensional cubes and scorecards. Additionally, based on the structured data exported from BI systems and other data sources, individuals often use various analytics tools to conduct further data analysis and manipulation, and create unstructured documents such as presentations and reports. Thus, the ability of the organisation to exploit the information is enhanced. Along these lines, we suggest that a high level of BI competency will lead to higher degrees of organisational absorptive capacity because BI objects are being used effectively to assess, assimilate, and apply knowledge. Accordingly, we make the following proposition:

***Proposition 1 (P1): The level of BI competency influences the degree of organisational absorptive capacity.***

To ensure business profitability and sustainability in increasingly-competitive markets, organisations need to devote energy to constantly exploring, acquiring, and exploiting new information from a wide variety of sources. Through an intensive information-assimilation process, organisations respond to emerging market demands by introducing new products and/or services (Oh & Teo 2008). In this regard, modern BI systems must be tightly assimilated to facilitate intelligent exploration, integration, aggregation, and multidimensional analysis of data originating from various sources. In addition to

specialised BI tools (such as digital dashboards), which can be accessed by business analysts and managers, contemporary organisations can effectively engage in information-sharing due to the advancements and proliferation of web technologies, especially Web 2.0 applications such as enterprise wiki, and groupware such as Microsoft SharePoint and IBM Lotus Notes (Oh & Teo 2008). The use of these web-based collaborative and knowledge-sharing tools would further support the organisational information absorption process and the dissemination of insights provided by BI. Based on Cadiz et al's (2009) view of absorptive capacity as a sequential process of assessing, assimilating, and applying new information, we propose that BI-based organisations with a high degree of absorptive capacity would be able to achieve high levels of BI assimilation. That is, the absorptive-capacity concept addresses the understudied issue of the link between BI competency and BI assimilation. Accordingly, the following proposition is made:

**Proposition 2 (P2):** *The degree of organisational absorptive capacity influences the level of BI assimilation.*

In operationalising the research, BI competency is measured against BI objects, BI operations, and BI knowledge. BI assimilation focuses on the degree to which BI is used to manage customer relations, business operations, marketing and sales (Elbashir et al. 2011), whilst organisational ACAP is measured by adapting the instrument of Cadiz et al. (2009) (i.e. assessment, assimilation, and application). Table 1 below depicts the operational definition for each component of the framework. In addition, the framework includes two ancillary factors that may affect BI assimilation; namely firm size (Davila & Foster 2005) and national culture (Richards et al. 2011) that function as control variables so as to isolate the primary influences on BI assimilation. The following subsections discuss the theoretical foundations of this study.

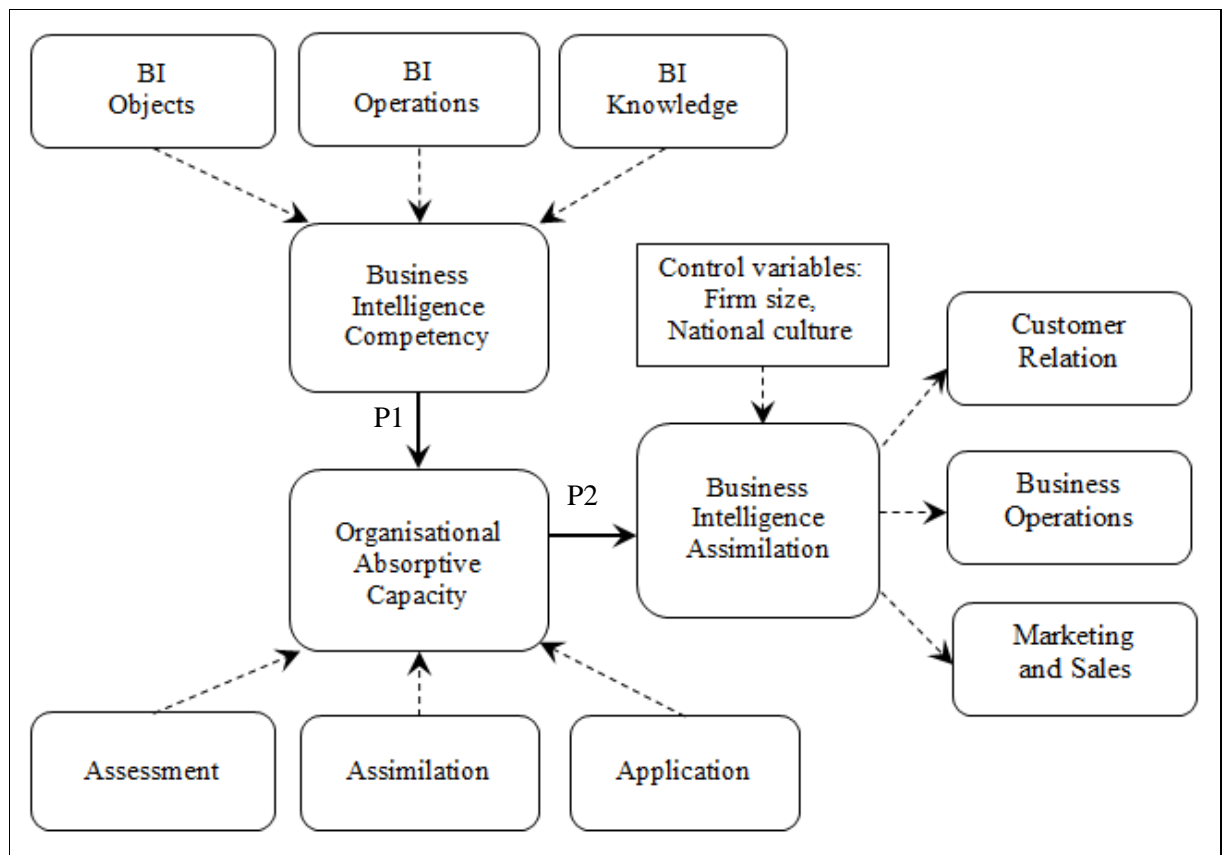


Figure 1. Conceptual framework

## **2.1 BI Assimilation**

Assimilation studies refer to “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). Originating from the concept of IT assimilation, BI assimilation represents an organisation’s extensive use of BI to support, shape, and enable business strategies and value chain activities. At a post-adoption assimilation stage, the main concern is whether a BI system has been implemented and used in a manner that delivers strategic benefits, which is the focus of this research. As depicted in Figure 1 above, the framework focuses on two critical components which are theorised to affect BI assimilation; namely, BI competency and organisational ACAP. BI assimilation will be measured by adapting Elbashir et al’s (2011) BI assimilation instrument. Building on Armstrong and Sambamurthy’s (1999) work, Elbashir et al. (2011) proposed three dimensions for BI assimilation: customer relations, business operations, and marketing and sales. Each dimension combines both generic strategies and business activities related to a specific business function. The operational definition for each dimension is provided in Table 1.

## **2.2 BI Competency**

Drawing on Tippins and Sohi’s (2003) concept of IT competency which comprises three critical components (i.e. IT objects, IT knowledge, and IT operations), BI competency refers to “the extent to which an organisation is knowledgeable about and effectively utilises BI to manage information within the firm”. Cumulatively, the three components of BI competency represent co-specialised resources indicating the organisation’s ability to utilise BI tools and processes for improved decision support. Although the three components are independent, their presence is required in order to achieve BI competency. For instance, while some organisations expend significant resources on such BI objects as software, hardware/infrastructure, and IT support personnel, there is no guarantee that those firms would achieve BI competency because they may lack the knowledge necessary to utilise the BI systems effectively. BI knowledge in this research is defined as “the extent to which a firm possesses a body of technical knowledge about BI systems”, and BI operations refer to the methods, skills, and processes required for completing an analytics task. Table 1 presents the operational definition of the three components of BI competency: BI objects, BI operations, and BI knowledge.

## **2.3 Absorptive Capacity**

The concept of absorptive capacity was proposed by Cohen and Levinthal (1989), being defined as a firm’s ability to identify, assimilate, and exploit knowledge. Recently Cadiz et al. (2009) added to this the component of value identification that had been advocated by Todorova and Durisin (2007). According to Cadiz et al. (2009), an organisation’s absorptive capacity is built on three subsidiary capabilities; namely, assessment (identification and filtering of valuable information), assimilation (conversion of new knowledge into usable knowledge), and application (the ability of the firm to use the assimilated knowledge to support its business activities and strategies). It is notable that these three first-order factors are combinative in nature and are path-dependent in facilitating absorption and use of new information. Along these lines, the second-order factor of overarching absorptive capacity in this study is measured by adapting the well-established first-order factors instrument of Cadiz et al (2009) (i.e. assessment, assimilation, and application), as depicted in Table 1.

<b>Variables</b>	<b>Operational definition</b>
<b>Business Intelligence Competency</b>	
BI Objects	<ol style="list-style-type: none"> <li>1. Our company has a formal BI department.</li> <li>2. Our firm employs a manager whose main duties include the management of our BI systems.</li> <li>3. Every year we budget significant funds for new BI software and hardware.</li> <li>4. Our firm creates customised BI applications when the need arises.</li> </ol>
BI Operations	<ol style="list-style-type: none"> <li>1. Our firm is skilled at collecting and analysing information via BI systems.</li> <li>2. We have set procedures for collecting information from disparate sources.</li> <li>3. We use BI systems to analyse business, customer, and market information.</li> </ol>
BI Knowledge	<ol style="list-style-type: none"> <li>1. Overall, our technical support staff is knowledgeable about BI systems.</li> <li>2. Our firm possesses a high degree of BI expertise.</li> <li>3. We are very knowledgeable about new BI applications.</li> </ol>
<b>Organisational Absorptive Capacity</b>	
Assessment	<ol style="list-style-type: none"> <li>1. People in my team are able to decipher the knowledge that will be most valuable to us.</li> <li>2. It is easy to decide what information will be most useful in meeting our customers' needs.</li> <li>3. We know enough about the BI we use to determine what new information is credible and trustworthy.</li> </ol>
Assimilation	<ol style="list-style-type: none"> <li>1. The shared knowledge within my team makes it easy to understand new information.</li> <li>2. It is easy to see the connections among the pieces of knowledge held jointly within our team.</li> <li>3. Many of the new BI applications coming to the team fit well into the current system.</li> </ol>
Application	<ol style="list-style-type: none"> <li>1. It is easy to adapt our work to make use of the new knowledge made available to us.</li> <li>2. New knowledge can be quickly applied to our work.</li> <li>3. My customers can immediately benefit from new knowledge learned in the team.</li> </ol>
<b>Business Intelligence Assimilation</b>	
Customer Relation	<ol style="list-style-type: none"> <li>1. BI helps to improve customer relations.</li> <li>2. BI supports the enhancement of existing products/services to customers.</li> <li>3. BI supports the creation of new products/services to customers.</li> <li>4. BI enables the provision of value-added goods/services to customers.</li> </ol>
Business Operations	<ol style="list-style-type: none"> <li>1. BI helps to improve supplier relations.</li> <li>2. BI supports the manufacturing and/or internal operations.</li> <li>3. BI enables the creation of flexible operations processes.</li> </ol>
Marketing and Sales	<ol style="list-style-type: none"> <li>1. BI enables better targeting of customers and tailoring of offers.</li> <li>2. BI enables increased sales and revenue.</li> <li>3. BI supports the decision to enter new markets.</li> </ol>

*Table 1. Operational definition used in this research  
(adapted from Tippins & Sohi 2003; Cadiz et al. 2009; Elbashir et al. 2011)*

### **3 CONTRIBUTIONS TO RESEARCH**

This research advances the knowledge base in several ways. Existing literature does not offer insights into the importance of an organisation's absorptive capacity for enabling effective use of BI. Therefore the first contribution of this research is that it bridges the gap between the as yet unrecorded and complex relationships between BI competency, organisational ACAP and BI assimilation by formulating a theoretically-grounded framework through extant literature. The conceptual framework represents the first attempt to understand the interplay between BI competency, organisational ACAP, and BI assimilation, and hence lays a theoretical foundation for future empirical study.

Second, while prior literature considers the importance of BI competency in realising BI benefits, what is interesting here - and what points to the theoretical significance of this research - is that previous studies have overlooked the crucial mediating mechanism of organisational absorptive capacity. This is precisely the impetus for this study: absorptive capacity theory is introduced as a fresh perspective to examine its mediating roles in the assessment, assimilation, and application of new information within a BI context. The prior study done by Elbashir et al. (2011) did not consider absorptive capacity from organisational perspective, nor take into account the role of BI competency. In other words, this research is the first account to study the effects of BI competency and organisational absorptive capacity, thereby advancing the current understanding of both as integral aspects of BI assimilation.

A third major contribution of the study is to the literature on information technology (IT) value. This research extends the IT-value literature to the BI assimilation context and seeks to evaluate the BI benefits. By examining BI assimilation in terms of customer relations, business operations, and marketing and sales, a better understanding will be obtained on the strategic benefits which organisations realise from their BI investments. In addition, another related contribution of this study is to the cross-cultural literature, for it considers the national cultural differences in adopting business intelligence.

A methodological contribution of the study is the synthesis of existing literature to forms of measurement and operationalisation which can better assess the three major components of the conceptual framework (i.e. absorptive capacity, BI competency, and BI assimilation). It offers a multidimensional view to empirically assess the three components of the conceptual framework, one of the first scholarly studies to do so. In particular, prior measurements have focussed only on certain aspects of BI competency without considering either the operational issues or the knowledge of the BI personnel. So by incorporating more diverse characteristics, this is consistent with calls that advocate that BI competency should be examined within their context rather than by means of the infrastructural object alone. In a broader sense, this research also addresses, through the theoretical lens of absorptive capacity, the heterogeneity in business performance noted across different organisations that have adopted business intelligence.

### **4 CONTRIBUTIONS TO PRACTICE**

This research offers a number of contributions to practice, especially for the BI stakeholders who are involved in planning, reviewing, or implementing BI initiatives.

First, BI adoption has become widespread as organisations continue to search for ways in which to support decision-making processes and business performance management. However, there is limited understanding of how BI competency leads to BI assimilation or to the strategic benefits to organisations. This study addresses the missing link and provides additional insights to BI stakeholders with regard to organisational absorptive capacity, and it helps explain why some firms may or may not be realising benefits from investing in BI.



Second, the conceptual framework highlights the need for BI stakeholders to consider BI competency from the perspectives of system knowledge, operations, and objects. Whilst the absorptive capacity takes into account the assessment, assimilation, and application dimensions, the BI assimilation should be measured against customer relations, business operations, and marketing and sales. A comprehensive perspective is valuable as it provides multi-dimensional views and covers the related elements which should not be taken for granted.

Third, BI professionals can use the measurement instrument developed in this study to evaluate, and to be informed of, the degree of organisational absorptive capacity, BI competency, and BI assimilation of a company. By knowing that figure, managers can ask the right questions about where to focus their scarce resources and attention, and it will enable them to devise strategies and implement corresponding initiatives to reap the benefits of implementing BI.

Finally, our conceptual framework may help explain why BI may not deliver the benefits expected by some firms. The absorptive capacity, which serves as the mediating factor in the framework, captures certain important underlying assumptions regarding BI assimilation. For instance, the optimal assessment, assimilation, and application of new information must exist if the organisation is to leverage the BI competency. If some of these conditions are not satisfied in a particular BI initiative then the BI competency may not realise the anticipated benefits. In other words, this framework may assist management to motivate their BI stakeholders to pay attention to the organisational absorptive capacity and so improve BI assimilation, thus realising the benefits of adopting BI.

## **5 CONCLUSION AND FUTURE RESEARCH**

This research has developed a conceptual framework proposing that absorptive capacity is the missing link between BI competency and BI assimilation. Our proposed framework lays the groundwork for future study to examine the relationships between BI competency, organisational absorptive capacity, and BI assimilation. There are numerous contributions to research and practice that can be derived from this research and from the conceptual framework.

In the following stage of this project the conceptual framework will be tested through a large-scale questionnaire survey of numerous business organisations in Australia, North America, and China (a major growth market for BI vendors). It will be necessary to collect samples from different regions because a broad variety of organisational characteristics will facilitate comparisons which will, in turn, provide further in-sights to the project. In fact, there are observed differences in terms of information systems implementation (Leidner & Kayworth 2006) and management decision-making styles in Asian countries (Park & Luo 2001). Therefore, it is expected that this study will identify differences between Asian and Western managers' perceptions of BI use. During the data analysis stage, we will test the interaction effect between BI competency, absorptive capacity, and BI assimilation, and explore if any other types, or orders, of relationships exist. Further, an empirical validation of the framework in a case study of a BI-based organisation would provide an in-depth understanding of the 'how' and 'why' issues for firms seeking to profit from BI investments.

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