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ENABLING FIRM PERFORMANCE THROUGH BUSINESS INTELLIGENCE AND ANALYTICS: A DYNAMIC CAPABILITIES PERSPECTIVE

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Abstract

This study draws on the sense-seize-transform view of dynamic capabilities as the theoretical lens for examining the role of BI&A in organizations. It views BI&A as the sensing and seizing components of dynamic capabilities that contribute to firm performance by enabling business process change. Findings confirm a positive relationship between BI&A and performance, mediated by business process change capabilities. This study answers the call for a

theoretically grounded examination of the relationship between BI&A and firm performance by highlighting the significance of the BI&A seizing capabilities, and the importance of business process change in translating BI&A output into improved performance.

Keywords: Business intelligence and analytics, firm performance, value of IT, dynamic capabilities, success

1. Introduction

As organizations strive for financial success in a world of rapid change and creative destruction, many invest in information technologies (IT) that promise improved performance through better informed decision making and faster action. Business intelligence and analytics (BI&A) is an umbrella term that refers to information systems that transform raw data into meaningful information and help reduce uncertainty in decision making (Clark et al. 2007). Business has embraced the promise of BI&A-enabled performance improvement by making BI&A a strategic priority, and is investing heavily in the underlying technologies. In fact, among all IT investments since 2009, BI&A represents the largest single expenditure by organizations (Kappelman et al. 2017). Furthermore, a recent research report conducted by MIT indicates that BI&A continues to be a strong source of improved business performance (Ransbotham and Kiron 2017). Despite the significant interest in these systems, organizations often realize differential benefits when implementing them. Scholarly investigations of BI&A use among practitioners report inconsistencies in the relationship between BI&A and firm performance. Although some report significant financial gains (Watson et al. 2006; Wixom et al. 2008), others have failed to fully realize the anticipated benefits (Phan and Vogel 2010). Some organizations actually report a decline in competitive performance after implementing BI&A (Kiron et al. 2011).

Unfortunately for practitioners seeking to maximize the return on their BI&A investments, the academic literature offers little normative guidance on the most appropriate and advantageous uses of BI&A. This can be largely attributed to gaps in our theoretical understanding of the mechanisms through which BI&A capabilities enable organizational benefits. Despite the fact that practitioners recognize the strategic importance of BI&A (Kiron et

al. 2011) and the term competitive advantage features prominently in BI&A research (Chen et al. 2012), no commonly accepted theoretical explanation of the link between BI&A and organizational performance has emerged. Much of the research about the link between BI&A and firm performance is *atheoretical* and exploratory in nature (Jourdan et al. 2008; Sharma et al. 2014). Several theory-based explanations, however, have been proposed based upon the IS success model (Wixom and Todd 2005; Wixom and Watson 2001), the resource based view (RBV) of the firm and its derivatives (Elbashir et al. 2008), information processing theory (Isik et al. 2013) and the dynamic capabilities perspective (Elbashir et al. 2013; Seddon et al. 2017). Of these, we argue that the dynamic capabilities perspective is the most promising in explaining how BI&A operates within organizations and the mechanism by which BI&A contributes to firm performance.

Dynamic capabilities theory seeks to explain organizational performance as a function of the ability of the firm to alter its resources. This focus is posited to be particularly useful under conditions of rapid environmental change. Thus, dynamic capabilities theory has been proposed as a promising theoretical foundation for studying the strategic value of IT (Drnevich and Croson 2013; Pavlou and El Sawy 2010, 2011) and for studying the link between BI&A and firm performance (Sidorova and Torres 2014). Its appeal is in its focus on strategic phenomena and its explicit delineation of the mechanism by which organizations achieve superior performance levels. The *sense-seize-transform* (SST) conceptualization of dynamic capabilities (Teece 2007) offers a particularly detailed view of how organizational adaptation occurs and how it results in improved performance. In this conceptualization, dynamic capabilities are decomposed into the organizational abilities to sense opportunities and threats, seize those occasions for organizational change, and then transform the processes of the organization. Because an oft-cited

objective of BI&A systems relates to sensing and shaping opportunities (Chen et al. 2012), Teece's conceptualization is particularly pertinent to explaining the effect of BI&A on firm performance. Because of the relative newness of the dynamic capabilities perspective, and the SST conceptualization in particular, application of the dynamic capabilities perspective in the area of BI&A has been limited. While some authors in the BI&A research community have drawn upon dynamic capabilities for theoretical guidance (Kim et al. 2011; Seddon et al. 2017; Wamba et al. 2017), no known study has explicitly examined BI&A capabilities through the SST lens. Although this conceptualization is aligned with the agility perspective widely used in the investigation of IT impact on organizational performance, the IT agility literature is inconsistent in its treatment of the organizational ability to sense, seize, and transform (c.f., Chakravarty et al. 2013). Our model clearly delineates these components and thus contributes to a more precise conceptualization of the relationship between BI&A and organizational performance. This study seeks to address this theoretical gap by developing a conceptual model of BI&A-enabled organizational benefits that draws upon the dynamic capabilities research in strategic management, and specifically the SST view (Teece 2007). The goal of this study is to address the following research questions:

1. Is the SST view of dynamic capabilities useful for explicating the role of BI&A in organizations?
2. How do BI&A capabilities relate to organizational performance?
3. How do BI&A capabilities, conceptualized as components of dynamic capabilities, relate to BI&A success factors in the extant literature?

By answering these questions, this study contributes to BI&A research in the following ways. First, it develops a new theoretically grounded conceptualization of BI&A capabilities and

empirically validates an operational definition of BI&A as components of dynamic capabilities. Second, it explicates and empirically validates the nature of the relationship between BI&A capabilities and firm performance. Finally, in light of the new theoretical perspective offered, the study validates the relationship of established BI&A success factors and the BI&A conceptualization proposed in this research. In addition, the study contributes to the dynamic capabilities literature by formulating and testing predictions based on the SST conceptualization of dynamic capabilities.

The remainder of this paper is organized as follows. The literature review section summarizes relevant literature on BI&A success and the use of BI&A to improve firm performance, as well as establishes the theoretical foundations of the study through an in-depth discussion of the dynamic capabilities view and Teece's SST perspective. Next, the research model is presented and testable hypotheses are developed. Third, the research method section describes the research protocols and methods designed to validate the research model and formally test its hypotheses. Fourth, we present the data analysis. Finally, the implications of the study findings are detailed along with the limitations of this research.

2. Literature Review and Theoretical Underpinnings

2.1 Business Intelligence and Analytics

The term Business Intelligence (BI) is used in academic research to refer to a variety of information management technologies, information seeking activities, as well as the informational output of such activities (Wixom and Watson 2010). BI has been also identified as a technology that can help organizations acquire, assimilate, and transfer new knowledge (Joshi et al. 2010). In this view, business analytics (BA) is the component of BI that focuses on the application of analytical techniques to answer organizational questions and improve decision

making (Davenport 2006). More recently, the term business intelligence and analytics (BI&A) has been proposed (Chen et al. 2012) to reflect both the growing importance of the analytical components of BI systems and the shift from reporting-centric capabilities to analysis-centric capabilities in BI applications (Sallam et al. 2014). We use the combined term for two reasons. First, it reflects the importance of both elements (Chen et al. 2012). Traditional BI platforms are shifting from reporting-centric capabilities to analysis-centric capabilities (Sallam et al. 2014). Thus, distinguishing between the terms due to differences in technical capabilities is becoming increasingly difficult. Second, BI and BA are viewed in practice as being so closely related that attempting to distinguish among the two terms may cause more confusion than it alleviates (Sallam et al. 2014). The terms BI and BA, for example, are commonly combined in reports on the subject (e.g., Sallam et al. 2014). Based on these syntheses of the terms, we define BI&A in this study as a *variety of organizational information practices that rely on the use of information technologies and involve the application of analytical techniques*. Our definition of BI&A is consistent with traditional academic definitions of BI, and therefore BI-related research is germane to the present study, particularly as it relates to the relationship between BI and firm performance.

2.2 BI&A and Organizational Outcomes

A number of theoretical perspectives have been employed to guide investigations of the role of BI&A in organizations and the relationship between BI&A and organizational outcomes, including the information systems (IS) success model (DeLone and McLean 1992, 2003), information processing theory, the resource based view (RBV) of the firm, and the dynamic capabilities perspective. The IS success model has shaped a significant portion of research on the organizational impact of BI&A (Isik et al. 2011, 2013; Popovič et al. 2012), yet it is not well

suited to explaining the mechanism by which benefits accrue as a result of the technology examined (Burton-Jones and Gallivan 2007). Consequently, BI&A research that is grounded in the IS success model rarely investigates the link between BI&A and firm performance. This is a gap that has been recognized in calls for theoretically-grounded research on BI&A benefits (Sharma et al. 2014).

Information processing theory, also commonly used in investigations of the role of BI&A in organizations (albeit not always explicitly referenced), is concerned with human information processing and postulates a relationship between problem space characteristics and information processing needs (Simon 1978). Although it has informed a number of BI&A studies that examine the link between BI&A and organizational benefits from a decision making perspective (Isik et al. 2013; Rouibah and Ould-ali 2002), it does not directly deal with the issue of organizational performance. Thus, studies grounded in this perspective typically do not extend beyond intermediary benefits of BI&A such as improved decision-making, speed to insight, and environmental awareness. Although valuable, such research does not directly test the mechanism through which these intermediary benefits influence firm performance.

The resource based view (RBV) of the firm is among the few theoretical perspectives informing BI&A research that explicitly includes firm performance as a dependent variable (Elbashir et al. 2008). RBV is an organizational level theory of firm competitive performance that suggests that resources are heterogeneously distributed across the market and that organizations imbued with resources which are valuable, rare, inimitable, and non-substitutable enjoy competitive benefits (Barney 1991; Wernerfelt 1984). Although RBV is a well-established theory in strategic management that is extensively used in the study of the value of IT investment (Drnevich and Croson 2013), it is not without criticism. In particular, critics of RBV contend that

the theory is tautological in nature, because firm value is derived from resources that are themselves valuable (Priem and Butler 2001). It is also argued that the definition of resources is too broad, making it difficult to adequately operationalize and test the tenets of the theory. In addition, RBV is criticized as a static theory, in which resources are characterized as difficult and expensive to create or to transfer among firms (Priem and Butler 2001). This characteristic of resources, also referred to as resource "stickiness," locks the firm into a particular course of action due to the inability of the organization to alter its path. Thus, RBV is ill-suited to explicating firm performance in dynamic environments (Teece 2007).

Extending the RBV perspective, recent studies employ the notion of BI&A *capabilities* as an intermediary link between BI&A success factors and organizational performance (Ramakrishnan et al. 2015; Seddon et al. 2017). Capabilities are defined as a "firm's capacity to deploy *Resources* (sic), usually in combination, using organizational processes, to effect a desired end" (Ambrosini et al. 2009, p. 35). BI&A capabilities are usually conceptualized as an organization's ability to deploy BI&A technology and personnel resources to produce valuable information outputs. The notion of BI&A capabilities is useful for integrating disparate findings of BI&A success studies because it encapsulates many aspects of existing IS success operationalizations and measures. The notion of BI&A as an organizational capability implies the use of BI&A technological resources, interactions between IT, human actors and organizational processes, and the usefulness of the BI&A output. Therefore, considering BI&A as an organizational capability, rather than simply as a technical asset, is a promising step towards clarifying the relationship between BI&A and firm performance (Sharma et al. 2010). Further progress along this path could be achieved by adopting theories such as the dynamic

capabilities perspective which explicitly acknowledge the importance of capabilities in achieving superior firm performance (Pavlou and El Sawy 2010; Wamba et al. 2017).

2.3 Dynamic Capabilities

Dynamic capabilities are "the firm's ability to integrate, build, and reconfigure internal and external competencies to address a rapidly changing environment" (Teece et al. 1997, p. 516). They are stable, structured, and patterned organizational processes that purposely change the ordinary capabilities of the firm and enable an organization to achieve competitive advantage through adaptation to a changing environment (Helfat et al. 2007; Helfat and Peteraf 2009). In the IS context, some attempts have been made to delineate the components of dynamic capabilities. For instance, Pavlou and El Sawy (2011) distinguish between sensing, learning, integrating, and coordinating capabilities. Here we employ the more parsimonious view offered by Teece (2007), who argues that dynamic capabilities can be decomposed into the organizational abilities to sense environmental stimuli, to determine an appropriate course of action, and then to transform the organization. Teece (2007) provides what is perhaps the most detailed model of dynamic capabilities in strategic management. We find this view of dynamic capabilities particularly useful for analyzing the link between BI&A and firm performance.

As the organizational environment evolves, the ability to *sense* new opportunities and threats is the first critical component of dynamic capabilities. Sensing capabilities are "analytical systems (and individual capacities) to learn and to sense, filter, shape and calibrate opportunities" (Teece 2007, p. 1326). Sensing is directly related to the strategic concept of diagnosis, a key component of sound business strategy (Teece 2014), and provides a critical information filtering function, limiting the volume of data which must be interpreted and thereby reducing the cognitive load experienced by organizational decision makers (Helfat and Peteraf

2014; Kor and Mesko 2013). This function is particularly important given the large volume of data that must be gathered and processed in order to detect opportunities and threats in the internal and external environment (Ambrosini et al. 2009; Hodgkinson and Healey 2011).

Sensing is necessary, but not sufficient, for organizational adaptation. Identified opportunities and threats must be *seized* upon by building consensus among stakeholders, making effective decisions, and investing organizational resources (Teece 2007). In order to initiate organizational change, consensus building is critical to overcoming organizational inertia (Teece 2007) and is a precursor of successful strategic action (Kor and Mesko 2013). Once shared understanding is built, the organization must make strategic decisions about how to invest its resources. In so doing, the firm undertakes the nontrivial task of evaluating the risk/reward scenario associated with action versus inaction (Teece 2007) and devising an action plan for adapting the organizational business model to take advantage of the opportunities or to mitigate threats (Ambrosini et al. 2009). As such, an ability to adequately plan the organization's business model is foundational to the seizing capabilities (Teece 2007).

Transforming, the third critical element of dynamic capabilities, involves the execution of organizational decisions and plans through redesigning the business model, realigning assets and revamping routines (Teece 2007). Transformational capabilities imply that the organization has the ability to direct and organize business processes in a manner that allows change to be performed effectively and in a timely manner (Helfat and Peteraf 2014; Hodgkinson and Healey 2011). Not surprisingly, many of the micro-foundations of transformation, including adopting loosely coupled structures, embracing open innovation, and developing integration and coordination skills (Teece 2007), are reflected in the literature on business process management (Kim et al. 2011; Rosemann and vom Brocke 2015). Successful transformation results in a better

alignment between the firm's ordinary capabilities and its environment that helps enhance the organization's competitive stance (Bowman and Ambrosini 2003; Helfat et al. 2007; Schreyögg and Kliesch-Eberl 2007).

2.4 Dynamic Capabilities and Firm Performance

Identifying sources of sustainable competitive advantage is not only a major goal of the strategic management field, it is a key motivation underlying the development of the dynamic capabilities perspective (Ambrosini and Bowman 2009; Teece et al. 1997). The prevailing view of the relationship between dynamic capabilities and competitive advantage has evolved over time (Arend and Bromiley 2009; Cepeda and Vera 2007; Helfat and Peteraf 2009). Early conceptualizations posited the relationship to be direct and necessary (Barreto 2010). It was believed that if an organization possessed strong dynamic capabilities it would attain sustained competitive advantage (Griffith and Harvey 2001; Teece et al. 1997). Current strategy research takes the view that dynamic capabilities impact firm outcomes through their effect on the firm's ordinary capabilities (Bowman and Ambrosini 2003; Helfat et al. 2007).

Because dynamic capabilities have been characterized as equifinal, thus neither inimitable nor immobile, they cannot be a direct source of sustained competitive advantage (Eisenhardt and Martin 2000). Instead, competitive advantage is derived by a firm's ordinary capabilities that have been transformed through the application of dynamic capabilities (Bowman and Ambrosini 2003; Helfat et al. 2007). The resulting competitive advantage is expected to be temporary rather than sustained, particularly in hypercompetitive environments where firms must focus on the continuous renewal of ordinary capabilities through the application of dynamic capabilities in order to outperform their competitors (Eisenhardt and Martin 2000; Zott 2003).

This is consistent with the view that simply possessing dynamic capabilities is not sufficient to create competitive advantage (Ambrosini and Bowman 2009; Eisenhardt and Martin 2000). This raises interesting questions regarding the practical application of the concept in organizations. What is needed to ensure that organizational use of dynamic capabilities results in competitive advantage, whether sustained or transient? Current research emphasizes the importance of decision making among organizational management in order to ensure that dynamic capabilities are applied correctly. An organization must use its dynamic capabilities "sooner, more astutely, or more fortuitously than the competition to create resource configurations that have that advantage" (Eisenhardt and Martin 2000, p. 1117). Both the timing of managerial decisions and managerial responses to environmental events may influence performance (Zott 2003). This suggests that not only should an organization successfully use the capability, but that failure to use them successfully could actually negatively impact the organization due to opportunity costs, the cost of maintaining the capability, and the market-imposed penalty for the selection of an inferior strategy (Helfat et al. 2007). Thus, rather than focusing on competitive advantage, measures of the performance of dynamic capabilities should include how well the dynamic capability enables the firm to make a change (Helfat et al. 2007).

3. Research Model and Hypotheses

Building on the SST view of dynamic capabilities, this study proposes that BI&A capabilities be conceptualized as sensing and seizing components of organizational dynamic capabilities[1]. This conceptualization suggests that the relationship between BI&A capabilities

[1] Although Teece does not explicitly specify the nature of the relationship among the three dynamic capabilities components, the process logic underlying his conceptualization suggests that a mediation model is the most faithful representation of the sense-seize-transform view.

and firm performance is mediated by business process change (BPC) capabilities, which represent the transformational component of dynamic capabilities, as well as functional performance which reflects organizational use of dynamic capabilities to optimize ordinary capabilities. BI&A success factors, as identified in prior research, are posited antecedents of BI&A capabilities.

Sensing opportunities and threats requires the acquisition and interpretation of information about both the internal operation of the firm and its environmental context (Schreyögg and Kliesch-Eberl 2007; Teece 2007). BI&A may be viewed as providing this type of capability (Sidorova and Torres 2014). Therefore, consistent with Teece, *BI&A sensing capability is defined here as the organization's ability to identify and shape opportunities through the gathering and analysis of data*. Building on Teece's model, this study extends the view of BI&A as an enabler of decision making by proposing a BI&A seizing capability construct. Seizing involves the integration and interpretation of information in order to arrive at a decision to act as well as planning the commitment of resources to support that action (Teece 2007). Consistent with Teece's conceptualization, we define *BI&A seizing capability as the organizational ability to make decisions, develop shared understanding among relevant stakeholders, and formulate an action plan in response to identified opportunities*. This is consistent with the view that effective BI&A should result in an impetus for organizational change (Sidorova and Torres 2014), and is in line with the call for research to look beyond insight as an outcome of BI&A (Sharma et al. 2014). Transforming involves the creation, renewal, or reconfiguration of the firm's ordinary capabilities in response to organizational decisions to act (Teece 2007). Drawing upon Teece, this study conceptualizes BPC capability as the transformational component of organizational dynamic capabilities. *BPC capability is*

defined here as is the firm's ability to effectively alter its business processes to exploit identified opportunities and avoid threats. BPC capabilities are necessary to translate the action plan developed through BI&A seizing capabilities into improved ordinary capabilities, and ultimately, improved organizational outcomes. The definitions for the remaining constructs employed in this study are derived from prior research and is discussed in the next section.

The research model employed in this study (Figure 1) is grounded in the BI&A success literature, the SST conceptualization of dynamic capabilities (Teece 2007), and research that demonstrates the importance of IT in the development of dynamic capabilities (Kim et al. 2011).

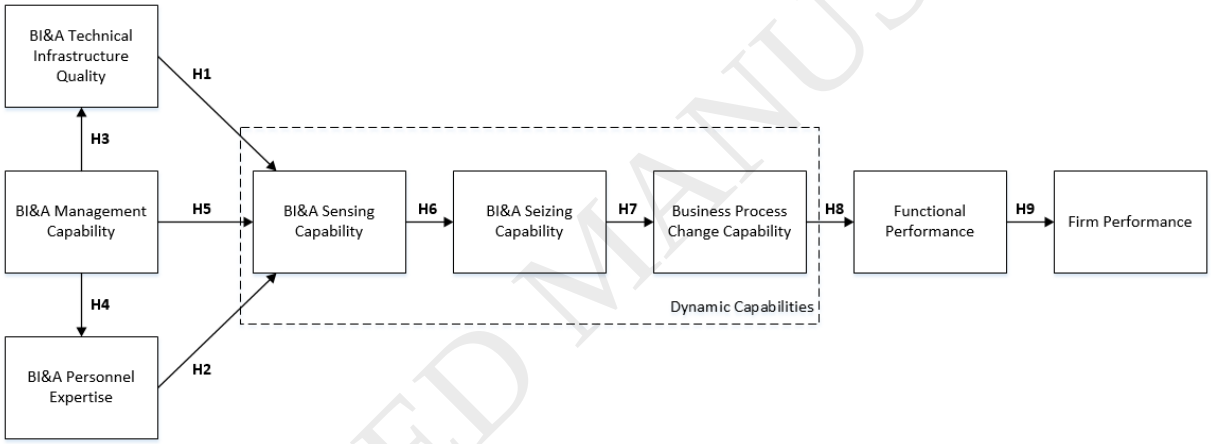

Figure 1. Research Model

3.1 Antecedents of BI&A capabilities

An extensive body of research examines BI&A success factors. In the Teece framework, microfoundations for sensing require specific knowledge, interpretation, filtering and creative activities. A review of research about BI&A success factors points to the quality of technical infrastructure, BI&A management capabilities, and personnel expertise as critical antecedents of BI&A success (Clark et al. 2007; Dinter 2013; Isik et al. 2013; Petter et al. 2013; Popovič et al. 2012; Wixom et al. 2008; Yeoh and Koronios 2010). Drawing on this body of research, we posit

that these constructs embody the specificity of the foundations required for BI&A sensing, and propose that these factors are positively related to BI&A sensing capabilities.

The ability to gather and analyze data implied by the BI&A sensing capability requires specialized IT infrastructure, often consisting of data storage, management and analysis tools (Elbashir et al. 2008). The sophistication of BI&A infrastructure is a key factor in the successful use of BI&A solutions (Elbashir et al. 2013). The quality of BI&A technical infrastructure encompasses both data quality and system quality. Data quality is essential in the context of BI&A because it directly influences the validity of the insights derived from that data (Yeoh and Koronios 2010) and must be sufficient to support the type of analysis being performed (Watson 2009). Inadequate data quality has been repeatedly shown to interfere with the ability of the organization to derive value from BI&A (Isik et al. 2011, 2013; Tamm et al. 2013; Wixom and Watson 2001). Data quality is closely intertwined with the quality of the system that is used for data storage and management. System quality, including the system's ability to integrate data from disparate data sources, is critical for ensuring data quality (Isik et al. 2013). System flexibility is another key component of system quality. The ability to sense opportunities requires sufficient flexibility of the system to address changing business needs (Yeoh and Koronios 2010). Because the quality of the BI&A infrastructure, including system quality and data quality, is critical to the ability of the organization to detect opportunities and threats, we posit the following hypothesis.

Hypothesis 1: BI&A technical infrastructure quality is positively associated with BI&A sensing capability.

BI&A personnel expertise is defined as the level of professional skills and knowledge possessed by BI&A staff. The skill of technical employees is a significant practical concern

(Kappelman et al. 2017), and human competency is a critical element of the successful delivery of BI&A services (Laursen and Thorlund 2017). A clear understanding of both the relevant technology and the problem domain have been identified as critical to the success of BI&A systems (Clark et al. 2007; Clark and Jones 2008; Najjar and Kettinger 2013; Seddon et al. 2017). Highly capable BI&A personnel are expected to produce information that is more accurate, useful, and insightful than personnel with lesser skills. The skills of those tasked with consuming this information also play an important role in effective sensing (Popovič et al. 2012; Seddon et al. 2017). If a highly skilled analyst produces an excellent model that is then interpreted by an organizational decision maker with little or no expertise working with such models opportunities and threats are likely to be missed. Thus, the expertise of consumers of BI&A output play a significant role in the sensing of opportunities and threats.

Hypothesis 2: BI&A personnel expertise is positively associated with BI&A sensing capability.

BI&A management capability is the ability of the organization to manage and ensure the use of BI&A resources. It encompasses the notions of management support and championship, both of which contribute to BI&A organizational and project implementation success by reducing political resistance to BI&A projects and encouraging organizational acceptance (Wixom and Watson 2001). Management support and championship help ensure high quality of both the BI&A system and its underlying data (Wixom and Watson 2001), and thus influence the quality of the BI&A technical infrastructure. This is consistent with BI&A research findings that management support is an important predictor of system quality and adequate information supply (Dinter 2013).

Hypothesis 3: BI&A management capability is positively associated with BI&A technical infrastructure quality.

BI&A management capabilities are also critical to the attraction, selection, development, and retention of necessary expertise among producers and consumers of BI&A output (Kiron et al. 2011). Management plays an important role in the creation of cultural values in any organization, and is expected to be critical to the creation of an analytical culture in which key decision makers feel comfortable with the use of analytical models.

Hypothesis 4: BI&A management capability is positively associated with BI&A personnel expertise.

Even when organizations possess valuable resources, improved organizational outcomes depend upon the effective use of such resources by management (Helfat et al. 2007; Helfat and Peteraf 2009). Management processes and support are important antecedents of the use of IT resources (Petter et al. 2013), which is essential to the derivation of organizational benefits (DeLone and McLean 2003). In BI&A research, this argument is supported by the finding that the ability of a firm to optimize its BI&A value is influenced by management's ability to proactively leverage BI&A assets (Gessner and Volonino 2005). The ability to sense opportunities and threats relies on the use of BI&A resources to develop organizational insight. BI&A management capability is, therefore, expected to have a positive effect on organizational BI&A sensing capability.

Hypothesis 5: BI&A management capability is positively associated with BI&A sensing capability.

3.2 BI&A Capabilities and Business Process Change

Although the ability to sense a threat or an opportunity is not sufficient for improving organizational performance, it represents a critical component of the *SST* triad of dynamic capabilities (Teece 2007). Drawing on Teece's model, we posit that BI&A sensing capability serves as a facilitator of BI&A seizing capability, i.e., the organizational ability to make decisions, develop shared understanding among relevant stakeholders, and formulate an action plan in response to identified opportunities. Superior BI&A sensing capabilities help create a more comprehensive picture of organizational threats and opportunities, and they help reduce uncertainty in decision making (Chakravarty et al. 2013; Teece 2007). The ability to effectively gather operational data is integral to the ability to analyze various courses of competitive action, and it is critical for developing an effective plan of action that is supported by major stakeholders. Organizations with superior BI&A sensing capabilities are expected to identify a greater number of opportunities than their counterparts without such capabilities. As a result, such organizations are expected to practice their seizing capabilities more frequently, which is necessary for the successful maintenance and improvement of these capabilities (Winter 2003). This is consistent with the dual model of process dynamization (Schreyögg and Kliesch-Eberl 2007) which argues that capability monitoring processes initiate changes in the capability practices of organizations.

Hypothesis 6: BI&A sensing capability is positively associated with BI&A seizing capability.

BPC capability is the firm's ability to effectively alter its business processes to exploit identified opportunities and avoid threats, and it represents the transformation component of dynamic capabilities. BPC capability depends on BI&A seizing capability for two reasons. First,

strategic action usually requires the support of various stakeholders (Parmar et al. 2010; Teece 2007). Superior BI&A seizing capability is expected to result in a shared understanding of organizational opportunities and threats as well as the agreement on a chosen plan of action among key decision makers. This allows the organization to exercise stronger leadership to overcome resistance and inertia, which are common obstacles of business process change (Hammer 2015). Second, superior BI&A seizing capabilities ensure tight linkages of organizational process change initiatives to strategic priorities by formulating an actionable change plan for the implementation of strategic decisions. Such strategic linkages are essential for successful business process change and effective transformation (Popovič et al. 2012; Rosemann and vom Brocke 2015).

Hypothesis 7: BI&A seizing capability is positively associated with BPC capability.

3.3 Functional and Firm Performance

Firm performance is the firm's ability to use its assets to generate revenues, measured in monetary terms. According to the dynamics capabilities literature, the effect of dynamic capabilities on firm performance is mediated by functional performance, i.e. the efficiency and effectiveness of a firm's ordinary capabilities (Bowman and Ambrosini 2003; Helfat et al. 2007; Protogerou et al. 2011). Functional performance is defined as the operational efficiency and effectiveness of the firm's business processes, and as such it reflects the degree to which the firm's ordinary capabilities are optimized for the current environment (Helfat et al. 2007). The transformation component of dynamic capabilities, represented here by BPC capabilities, is integral to an organization's ability to optimize its processes in relation to the internal and external environment, and thereby maximize its competitive performance (Schreyögg and

Kliesch-Eberl 2007). The ability of the firm to quickly reconfigure sub-optimal processes enables it to increase the complexity of its action repertoire (Sambamurthy et al. 2003).

The link between the efficiency and effectiveness of a firm's processes and its financial performance is well established in the IS literature (Frei and Harker 1999; Ramirez et al. 2010) and has been noted as particularly important in the BI&A context (Wamba et al. 2017). Improving the efficiency of organizational processes reduces the costs associated with the operation of the firm, thereby improving its bottom line (Ramirez et al. 2010). Effectiveness of business processes ensures that products and services produced are commensurate with the needs of internal and external customers. Thus, both theoretical reasoning and empirical evidence point to the positive relationship between functional and firm performance.

Hypothesis 8: BPC capability is positively associated with the level of functional performance.

Hypothesis 9: Functional performance is positively associated with firm performance.

4. Research Method

The proposed research model was tested using a field survey, a method successfully used in research on BI&A success (Isik et al. 2013) and dynamic capabilities (McKelvie and Davidsson 2009). Consistent with existing research practice, we relied on key informants to gain insight into organizational BI&A practices, a common strategy for gaining insight on organizational issues (Benlian et al. 2011). A key informant was defined as a person at a middle management position or higher with knowledge of the use of BI&A within their organization. Measures taken to ensure that the informant possessed appropriate knowledge to respond to the survey are discussed in the data collection section.

The survey instrument included items for measuring the model's constructs and demographic information about the organizations and informants. Where possible, items were adapted from scales that had been validated in prior research. Because BI&A sensing and seizing capabilities are newly proposed constructs, items for measuring them were developed by the researchers in a multi-step process. First, guided by the dynamic capabilities and BI&A literature, one of the authors developed the items. Second, a panel of academic experts reviewed each construct, its definition, and its associated items in order to evaluate the face validity of the instrument. This resulted in the revision of the proposed scales. Third, all developmental items went through a multi-round Q-Sort procedure (Moore and Benbasat 1991). Finally, a pretest of the entire survey instrument was conducted using MBA students with professional BI&A experience. The results of this pretest were used to assess the psychometric properties of the instrument and identify any final adjustments to item content. No changes to the developmental items were necessary following either the Q-Sort or the pretest. Additional detail about the process by which items were developed may be found in the Appendix.

4.1 Construct Operationalization and Control Variables

Construct operationalization for BI&A sensing and seizing capabilities was guided by the conceptualization of sensing and seizing as components of organizational dynamic capabilities and the construct definitions adopted for this study. BI&A sensing capabilities were operationalized using two dimensions: internal and external sensing. Items for measuring the internal dimension of BI&A sensing capabilities focused on detection of opportunities related to the improvement of the efficiency and effectiveness of internal business processes. Items for measuring the external dimension of BI&A sensing capacities focused on monitoring the external environment and market conditions. BI&A seizing capability was operationalized as a

three-dimensional construct consisting of decision making, shared understanding, and planning abilities of the firm. Items for capturing decision-making capabilities reflected the ability of the organization to be decisive in the face of an opportunity or threat. Items used to assess the ability of the organization to develop shared understanding focus on the ability to reach consensus among stakeholders with respect to the response to an opportunity or threat. Items for capturing planning capabilities reflected the firm's ability to develop effective action plans in order to capitalize on identified opportunities, which is consistent with Teece's view that "tight planning will be a part of seizing" (Teece 2007, p. 1343). Scales for existing constructs were adapted from a variety of sources. All constructs, dimensions and measurement items and the sources from which they were adapted or derived are provided in the Appendix. In addition, the survey captured the following organizational level demographic variables to serve as controls: organizational size measured by firm revenue and number of employees, organizational age measured by years in operation, organizational experience with BI&A measured in years, and industry turbulence measured using a five-item perceptual scale (Arend 2012). A number of demographic variables about the informants were also collected and used to ensure that the respondents met our criteria for a key informant.

4.2 Data Collection

Assessing BI&A requires a knowledgeable business professional with enough seniority to have acquired the organizational viewpoint necessary to accurately report on the effectiveness of their firm's data collection, analysis, interpretation, and transformation processes. Because our interest is studying BI&A in organizations that have incorporated it into their dynamic capabilities, respondents must also reside in organizations of sufficient size and resources that they have at least the potential to do so in such a way that it impacts firm performance. Many

organizations have more narrowly utilized BI&A or have utilized it in ways that impact pieces of the firm, but not overall firm performance or that have not provided them significant advantage in the marketplace (Isik et al. 2013). Thus, criteria for selecting participants included finding those that could be expected to both reside in the organizations of interest and to be at a level in the organization to have sufficient knowledge about their organizations' BI&A and dynamic capabilities. In addition, because BI&A may be enacted and used for different purposes in different industries, we wanted to ensure adequate industry representation. Because there is no easily available sampling frame for this population that fit our criteria and business executives tend to be hard to reach and involve in research, a modified snowball sampling technique was employed (Goodman 1961). In this modification, initial seeds are selected via a convenience sample of members in rare populations (Thompson 2002), an approach commonly employed by IS researchers (e.g., Campbell et al. 2013; Sarker et al. 2010).

In this study, the sources for the initial sample were the professional networks of the authors. This approach has been used previously in IS research (Ågerfalk and Fitzgerald 2008; Califf et al. 2016; Leidner and Mackay 2007), and had the advantage of targeting respondents at a high organizational level and in organizations believed to be capable of using BI&A in a dynamic capabilities context. Selection was not based on a pre-conceived judgement about whether they had successfully done so, only that the company had sufficient resources for it. Personalized invitations were sent to 227 business professionals via email or the messaging feature of LinkedIn, and a reminder email was sent to each individual approximately 2 weeks after receipt of the initial invitation. Of the 227 invitations, 127 asked the recipient to participate in the study and forward the message to others in their personal network. The remaining 100 invitations only asked the recipient to forward the message to members of their network. This

approach was selected because it has been shown to improve the characteristics of the sample (Christopoulos 2009). To ensure informants were well positioned to respond to the survey and to allow for self-screening, messages inviting participants to respond specified that they need to be business executives in firms using BI&A. Further, informants were validated based on responses to questions that assessed their level and tenure within the organization, as well as their knowledge of organizational BI&A activities. The recruitment materials and data analysis procedures were designed to minimize the possibility of multiple informants for the same firm. Specifically, recipients charged with forwarding the invitation to others in their professional network were asked to forward to as many contacts as possible at the appropriate level, but to limit forwards to one contact per business.

A total of 171 responses were received over a 47 day period. Of these, 16 responses were incomplete and were excluded from analysis. An additional 5 responses were identified as duplicate responses for organizations already represented in the sample and were also excluded from consideration. In these situations, the response from the most senior respondent was retained because it was assumed they would be best able to represent their organization as a key informant. Finally, 13 responses came from organizations that identified themselves as academic, governmental, or not-for-profit. Because the dependent variable in this research is firm performance (measured in terms of financial indicators), these responses were also excluded. Thus, a total of 137 observations were retained for analysis following this screening procedure. As shown in Table 1, and consistent with our target population, the respondents represented a variety of managerial roles, including C-level executives, vice-presidents, directors, and senior managers.

Table 1. Respondent Roles

Role	Count	Percentage
Account Executive	2	1.46%
Analyst	4	2.92%
Architect	4	2.92%
Associate	1	0.73%
Chief Architect	1	0.73%
C-Level	16	11.68%
Consultant	2	1.46%
Director	25	18.25%
Executive Director	1	0.73%
Fellow	1	0.73%
Founder	2	1.46%
Lead	4	2.92%
Manager	16	11.68%
Managing Director	3	2.19%
Other	4	2.92%
Partner	2	1.46%
Principal	2	1.46%
Project Manager	1	0.73%
Regional Manager	3	2.19%
Senior Account Executive	1	0.73%
Senior Analyst	5	3.65%
Senior Consultant	3	2.19%
Senior Director	8	5.84%
Senior Engineer	1	0.73%
Senior Manager	8	5.84%
Senior Principal	1	0.73%
Senior Specialist	1	0.73%
Senior Statistician	1	0.73%
Specialist	2	1.46%
Technical Supervisor	1	0.73%
Vice President	11	8.03%
TOTAL	137	100.00%

The majority of the represented organizations reported annual revenues in excess of $1 billion and an employee headcount of more than 10,000 individuals. Thus, they meet the criteria of residing in organizations large enough to have the potential to enact BI&A in the context in

which we are interested. Although the key informant approach has limitations pertaining to the ability of a single respondent to knowledgably report on a variety of organizational BI&A activities, the snowball sampling approach was employed to mitigate these concerns by enabling us to identify respondents with sufficient knowledge and expertise to provide well-informed answers. Respondents had, on average, about 10 years of experience with BI&A, and thus could be expected to have sufficient understanding and knowledge of the aspects of BI&A in this study. As displayed in Table 2, responding organizations represented 25 industries, including telecommunications, professional services, financial services, utilities, and healthcare.

Table 2. Industries Represented

Industry	**Count**	**Percentage**
Aerospace/Defense	4	2.92%
Automotive	2	1.46%
Business Professional Services	6	4.38%
Chemical	1	0.73%
Construction	1	0.73%
Consumer Goods	7	5.11%
Electronics/Semiconductor	2	1.46%
Energy	5	3.65%
Financial Services/Insurance	16	11.68%
Food Services	2	1.46%
Healthcare/Medical	11	8.03%
Hospitality/Travel/Leisure/Tourism	6	4.38%
IT Services/Consulting	25	18.25%
Manufacturing	2	1.46%
Media/Entertainment	3	2.19%
Medical Technology/Biomedical	1	0.73%
Mining/Minerals	2	1.46%
Printing/Publishing	1	0.73%
Real Estate	3	2.19%
Retail/Wholesale	5	3.65%
Telecommunications	10	7.30%
Transportation/Distribution	2	1.46%

Utilities	5	3.65%
Other	15	10.95%
Total	137	100.00%

Because this study used snowball sampling where each participant was encouraged to invite others to participate, it is difficult to accurately determine the response rate. However, some indication of response rate may be gleaned through the response-to-invitation ratio. In total, 227 personalized invitations yielded 155 complete responses for a 0.68 response-to-invitation ratio. Non-response bias was assessed by comparing early responders to late responders, a method based on the assumption that late responders are more similar to non-responders than to early responders (Armstrong and Overton 1977). The results of independent samples t-tests indicated no significant response bias.

5. Data Analysis

5.1 Assessment of the Measurement Model

The psychometric properties of the survey instrument were assessed using a variety of techniques. Because some scales were developed for purposes of this study, scale convergent and discriminate validity were assessed using exploratory factor analysis (EFA). As a result, items that cross-loaded on more than one factor or that exhibited low item loadings were removed (noted with an asterisk in Table A3). The results of the EFA are presented in the Appendix. The reliability of the final measurement scale was assessed by calculating Cronbach's alpha. All alphas exceeded 0.80, indicating sufficient reliability of the measurement scales (Nunnally and Bernstein 1994). Next, the convergent validity of the final model was assessed through examination of the outer loadings of the indicators and the average variance extracted (AVE). All outer loadings associated with the final measurement scales exceeded

0.708, the established guideline for demonstrating satisfactory convergent validity (Henseler et al. 2009), with the exception of one of the items used in the management capabilities scale (*ManCap1* with the loading of 0.645). The inclusion of the item did not negatively impact the reliability of the construct or make a material difference to the AVE, thus the item was retained. All observed AVE values exceeded the 0.50 guideline (Henseler et al. 2009). Finally, the discriminant validity of the final scale was assessed using the Fornell-Larker criterion (Fornell and Larcker 1981). All latent variable correlations fell below the square root of the AVE, indicating adequate discriminant validity. Details of measurement model assessment are presented in the Appendix.

5.2 Test of the Structural Model

Structural model testing was conducted using partial least squares structural equation modeling (PLS-SEM), an approach that employs ordinary least squares and that is commonly utilized in information systems research (Hair et al. 2017). PLS-SEM was selected over covariance-based structural equation modeling (CB-SEM) for two reasons. First, and most importantly, studies demonstrating the empirical applicability of the SST view of dynamic capabilities in the context of BI&A are entirely lacking. This study not only attempts to apply SST in this context, but strives to integrate constructs commonly used in IS success research. Thus, this research may be characterized as an exploratory extension to existing theory. PLS-SEM is appropriate in such situations (Hair et al. 2017, 2011; Lowry and Gaskin 2014), as it has been shown to produce similar estimates to CB-SEM (Reinartz et al. 2009) while avoiding the factor indeterminacy issue that is present in CB-SEM (Lowry and Gaskin 2014). Second, PLS-SEM is preferred over CB-SEM when the structural model is complex. The research model specified herein contains a large number of constructs, some of which are modeled as higher

order constructs. In the face of such model complexity, PLS-SEM may be more appropriate than CB-SEM for structural model testing (Hair et al. 2017, 2011; Lowry and Gaskin 2014).

Because several of the constructs were conceptualized as multi-dimensional reflective-formative constructs, a two-step process was used to test the structural model (Lowry and Gaskin 2014). In the first step, a model was tested in which the indicators for first-order constructs were repeated on the second-order constructs. In the second step the latent variable scores from step one were captured and used as indicators in a subsequent model. Thus, first-order constructs were measured using reflective scales and then used as formative indicators of the second-order constructs. This is consistent with our conceptualization of the first-order constructs as independent dimensions of the second-order constructs. This allowed for the effects of the first-order constructs to be captured and produced interpretable results (Lowry and Gaskin 2014). The final model was fit using the latent variable scores from step one and the PLS algorithm was used to produce path coefficients for the relationships between constructs and R-square values for all endogenous constructs. Levels of significance were estimated using a bootstrap technique with 5,000 re-samples as advocated by Hair et al. (2014). The results are displayed in Figure 2.

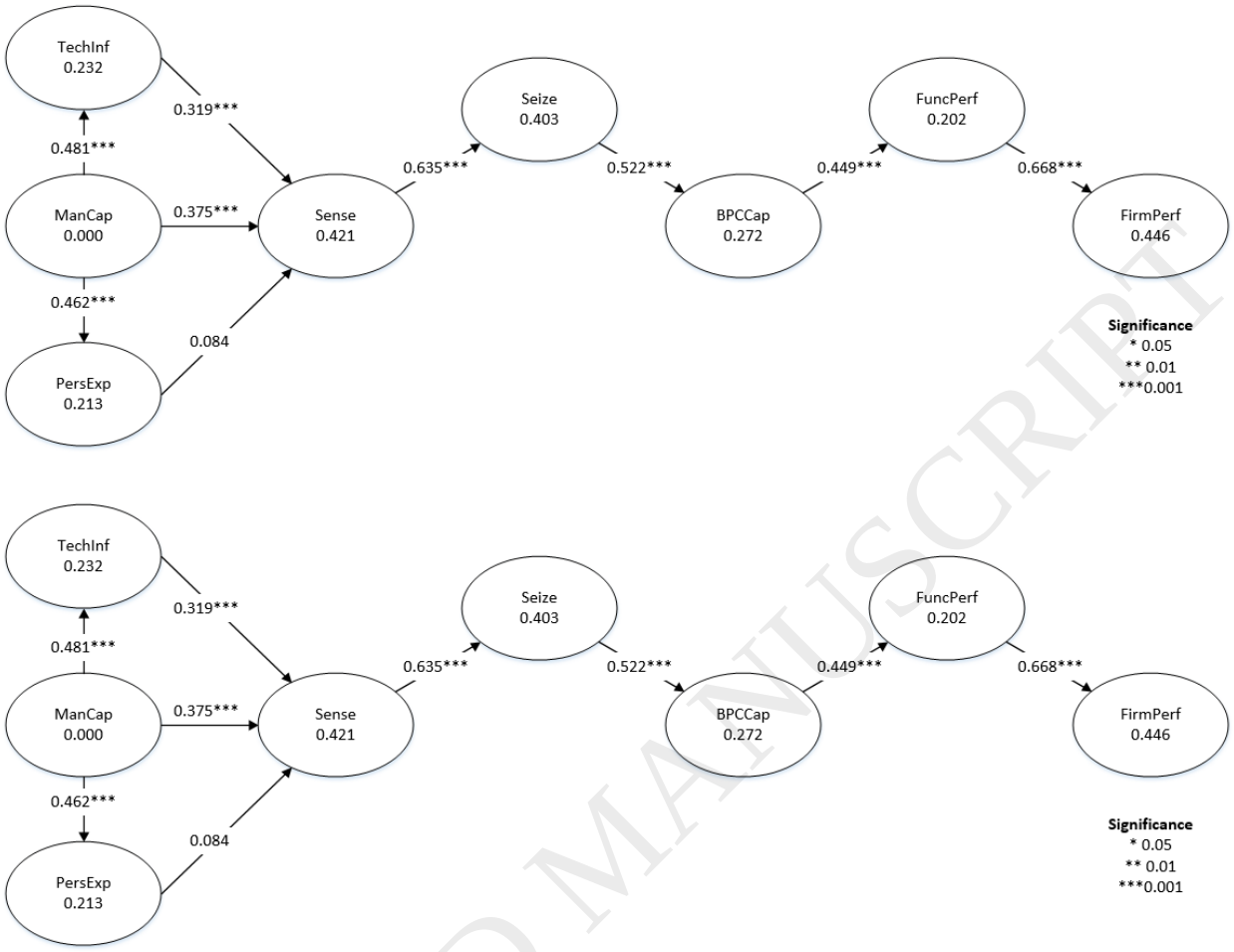

Figure 2. Final Model with Path Coefficients, R-Square Values, and Levels of Significance

All paths were found to be significant at the p=0.001 level with the exception of the relationship between BI&A personnel expertise and BI&A sensing capability (Hypothesis 2). These findings remain true even when controlling for revenue, number of employees, firm age, years of experience with BI&A and industry turbulence[2]. Of these controls, only number of

[2] Industry turbulence was included in the model as a predictor of functional and firm performance. Although, no direct paths between industry turbulence and dependent variables were significant, some of the interaction effects involving industry turbulence were found to be significant predictors of BI&A seizing capabilities

employees and firm age were significant at the 0.05 level. The inclusion of these items in the model resulted in a 0.05 increase in the R-square of firm performance, with no material impact on the significance of the relationship between functional and firm performance. The R-square values range from 0.202 (functional performance) to 0.446 (firm performance), indicating adequate explanatory power of the model. A summary of hypothesis testing results is presented in Table 3.

A post-hoc analysis provided support for the mediation model of the relationship between BI&A and firm performance. To further examine the appropriateness of the mediation model, we evaluated a model where direct effects of BI&A sensing and seizing capabilities on functional performance were included. The direct effect of BI&A seizing capabilities was found significant, but only when the direct effect of BI&A sensing was removed from the model. This suggests that the relationship between BI&A seizing and functional performance is only partially mediated by BPC capabilities. In addition, the analysis also revealed that the effect of BI&A technical infrastructure and BI&A management capabilities on BI&A seizing capabilities is only partially mediated by BI&A sensing capabilities. The direct effect of BI&A technical infrastructure on business process change capabilities was also significant.

Finally, we evaluated a model in which BI&A sensing, BI&A seizing, and business process change capabilities were treated as dimensions of a higher order dynamic capabilities (DC) construct. While the relationships between the antecedents and the DC construct as well as between the DC construct and functional performance were found significant, this treatment

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and firm performance. This is consistent with the dynamic capabilities literature that suggests that although dynamic capabilities are most critical in turbulent environments, they may also play an important role in relatively stable markets (Ambrosini et al. 2009; Pavlou and El Sawy 2010; Protogerou et al. 2011).

masks the mechanism exposed in our deconstructed view. Alternative models assuming interaction effects between the individual elements of the dynamic capability were examined but did not provide useful insights.

Table 3. Hypothesis Testing Summary

Hypothesis	Path Coefficient	t-Value	Supported
Hypothesis 1: BI&A technical infrastructure quality is positively associated with BI&A sensing capability.	0.319	4.351	Yes
Hypothesis 2: BI&A personnel expertise is positively associated with BI&A sensing capability.	0.084	0.946	No
Hypothesis 3: BI&A management capability is positively associated with BI&A technical infrastructure quality.	0.481	7.442	Yes
Hypothesis 4: BI&A management capability is positively associated with BI&A personnel expertise.	0.462	6.385	Yes
Hypothesis 5: BI&A management capability is positively associated with BI&A sensing capability.	0.375	4.876	Yes
Hypothesis 6: BI&A sensing capability is positively associated with BI&A seizing capability.	0.635	10.342	Yes
Hypothesis 7: BI&A seizing capability is positively associated with BPC capability.	0.522	6.513	Yes
Hypothesis 8: BPC capability is positively associated with the level of functional performance.	0.449	5.973	Yes
Hypothesis 9: Functional performance is positively associated with firm performance.	0.668	11.082	Yes

Because no significant relationship was found between BI&A personnel expertise and BI&A sensing capability, a post-hoc power analysis was performed for BI&A sensing capability at the 0.05 probability level. The resulting observed value, >0.999, far exceeds the recommended minimum of 0.80 (Cohen 1988), suggesting our sample provides adequate statistical power for testing the relationship.

Two approaches were used to test for the presence of common method bias. First, the result of Harman's single-factor test indicated the first factor accounted for 33.811% of the variance in the model, suggesting common method bias was not present. A second assessment

was conducted using a theoretically unrelated marker variable inserted into the questionnaire, which is a technique prevalent in PLS-based research (Lowry and Gaskin 2014). The test indicated low correlation between the marker (presence of diversity policies within the organization) and all other constructs (maximum correlation of 0.321 between the marker and external sensing). Thus, the majority of variance is explained within, rather than shared among, the constructs, and common method bias was not judged to be present.

6. Discussion

6.1 Implications for Research

One objective of this study was to evaluate the fitness of the SST view of the dynamic capabilities framework as a theoretical basis for conceptualizing BI&A. To achieve this objective, following Teece's SST framework, we defined BI&A sensing and BI&A seizing capabilities as separate constructs. The results of the measurement model evaluation provide support for the proposed definition and operationalization of BI&A sensing and seizing capabilities. BI&A sensing capability is positively associated with BI&A seizing capability, supporting the notion that organizations that can sense a wider variety of competitive actions also seize a greater number of opportunities than their rivals. Positioning BI&A within a wider organizational context, our study finds a positive relationship between BI&A and BPC capabilities, an instantiation of organizational transformation capabilities. Viewed holistically, these results make two important contributions to the BI&A and dynamic capabilities literature. First, the results demonstrate that the SST view provides a useful theoretical framework for examining BI&A. Second, this study is among the first to operationalize and empirically test the SST view of dynamic capabilities. Thus, the study contributes to the dynamic capabilities

literature by providing empirical support for Teece's framework. Being mindful, however, of the slippage that may occur in interpretation of the process components of the model (Seddon 1997), these findings should be interpreted with the understanding that sensing and seizing are often temporally and proximally removed from one another. Thus, our empirical findings support the premise that BI&A sensing is necessary, but not sufficient for BI&A seizing.

Another objective was to explicate the nature of the link between BI&A and firm performance. The dynamic capabilities perspective deals specifically with factors that enable superior firm performance, and thus it offers a promising theoretical lens through which to examine the relationship between BI&A and improved organizational outcomes. The empirical results show that our model explains 20% of variance in functional performance, and 45% of variance in firm performance. This corroborates the mainstream practitioner view of BI&A as a strategic investment. Our results, however, imply a more complex relationship between BI&A and organizational outcomes than is explicitly shown in existing models. Specifically, our results confirm that the relationship between BI&A and functional performance is, to a large degree, mediated by process change capabilities. This is consistent with the view that dynamic capabilities operate through their influence on the ordinary, value-generating processes of the firm (Bowman and Ambrosini 2003; Helfat et al. 2007; Pavlou and El Sawy 2010). Organizations with superior process change capabilities have often fully documented the resources and control-flow dependencies of their value-generating processes and have designed them to be more modular (Harmon 2015). Thus, the alteration of such processes is easier and can be exercised to improve functional and firm performance (Harmon 2015). Although the relationship between functional and firm performance may be intuitive, the mediating role of functional performance is often overlooked in IS research (Dehning and Richardson 2002). By

including both functional and firm performance in the research model, this study highlights the fact that BI&A influences firm performance through its impact on functional performance. In sum, by clarifying the role of BI&A as a component of organizational dynamic capabilities and by describing the complex mediation chain by which BI&A impacts functional and firm performance, this study contributes to current research by answering the call for a theoretically grounded examination of the strategic role of BI&A (Jourdan et al. 2008; Sharma et al. 2014). In explicating this relationship, the study integrates theoretical concepts previously examined separately in BI&A, BPM, and strategic management literature, and thus positions BI&A within the larger organizational context.

The third objective was to relate BI&A capabilities to BI&A success factors identified in prior research. This is important because the conceptualization of BI&A as sensing and seizing components of organizational dynamic capabilities is different from the more technical view of BI&A commonly adopted in BI&A research. Consistent with extant BI&A success factors research, our findings support the premise that BI&A management capability positively influences BI&A sensing capabilities, both directly and indirectly through its effect on BI&A technical infrastructure. Management is critical to the successful integration of BI&A with business processes (Elbashir et al. 2011) because it champions the use of BI&A, and enacts policies that impact the success of BI&A initiatives (Clark et al. 2007). Our findings also indicate that the quality of BI&A technical infrastructure, including system and data quality, plays a significant role in the development of BI&A sensing capabilities. The quality of information systems and the data they provide are particularly important in systems that are designed to support decision-making and have been demonstrated as factors critical to the success of BI&A systems. This is consistent with the literature which suggests that issues related

to the quality of the systems and data underlying BI&A represent a threat to the ability of the firm to extract value from its BI&A systems (Tamm et al. 2013).

Perhaps the most interesting finding related to the BI&A success factors is the lack of a significant effect of BI&A personnel expertise on BI&A sensing capabilities. Although surprising in light of the literature which suggests that human competency is an important antecedent of effective BI&A use (Elbashir et al. 2011), interpretation of this finding is aided by considering the role of BI&A management capabilities. Post-hoc testing revealed that the relationship between personnel expertise and BI&A sensing is significant when BI&A management capabilities are not included in the model. Taken together these results suggest that management capabilities may offset deficiencies in personnel expertise. In sum, our results contribute to IS research by demonstrating that BI&A success factors identified in prior studies are relevant antecedents of BI&A conceptualized as a component of dynamic capabilities.

Theory testing and theory building are both recognized as vital to advancing theories. This research contributes to theory building by conceptualizing sensing and transforming capabilities as critical factors in translating BI&A insight into firm performance. It makes a significant theory testing contribution by assessing relationships that are grounded in existing theory. As such, the overall theoretical contributions of this work fall between the testers and expanders categories of the taxonomy of theoretical contributions for empirical articles, and represents a significant theoretical contribution to existing research (Colquitt and Zapata-Phelan 2007). Because sensing, seizing and transforming were originally posited in the SST framework as necessary, but not sufficient factors for impact, additional research is necessary to build upon the foundation our findings provide. For example, case studies of one or multiple organizations could draw upon the theoretical contributions of our work to provide more in-depth and/or a

more broad-based understanding of how these factors work together in the BI&A context. Our work could also provide a foundation on which to expand the boundaries around the SST piece to include other BI&A or organizational factors that enhance the impact of either the SST pieces or the capabilities as a whole.

6.2 Implications for Practice

The findings of this study have four important implications for organizations seeking to maximize the impact of their BI&A investments. First, the results of this study support the contention that BI&A may be viewed as a strategic investment that ultimately influences firm performance. By demonstrating the causal chain between BI&A and firm performance, this study provides empirical evidence that may serve as a basis for business executives seeking to justify investments in BI&A. Because the SST framework aligns well with traditional functions of BI&A within organizations, it offers intuitive theoretical guidance that practitioners may draw upon to better understand the complex relationships necessary to extract value from BI&A. Our findings suggest that to exploit BI&A resources, firms must recast BI&A from a technical asset to a firm capability critical to competitive success. Although this is not a new idea, calls for organizations to do so typically are grounded in financial, structural or cultural imperatives (Watson et al. 2006; Wixom and Watson 2010). Our work provides a different perspective within which firms can view leveraging their BI&A assets as dynamic resources that can enable them to continually build and adapt in response to a continually changing environment (Teece 2007).

Second, our findings highlight the importance of opportunity seizing in realizing the value of BI&A investments and suggest that the development of shared understanding, decision-making, and planning should be considered integral parts of BI&A capabilities. This implies that in parallel with technical investments in BI&A infrastructure and personnel, firms should invest

in organizational practices that support effective communication and information sharing among key stakeholders. Although firms are often advised to streamline decision-making and planning processes to ensure that timely decisions and effective plans can be made in response to opportunities, our framework places this best practice in a chain of activities that translate BI&A investments into enhanced firm performance.

Third, an underlying assumption in the BI&A literature has been that deriving value from BI&A improved decision-making decisions requires action. This study confirms this assumption and shows that in order to realize the benefits of BI&A, it is not sufficient to simply gain insight. Organizations must respond to the information provided by BI&A systems by reconfiguring organizational resources in a manner that adequately implements their decisions. A firm's failure to capture value from BI&A can be attributed not only to inadequate BI&A outputs, but also to an inability to act upon such outputs. Hence, the assessment of benefits derived from BI&A investments should be conducted in conjunction with an evaluation of organizational process management and change management practices.

Finally, our study confirms the importance of strong management capabilities and high quality technical infrastructure for identifying competitive opportunities and threats through. Although the relationship between these factors and BI&A success is well established in the literature, our study points to the possibility that superior management capabilities can help mitigate the effect of less developed personnel expertise. In other words, organizations may consider substituting investments in more expensive BI&A personnel for investments intended to motivate BI&A use among current employees and establish standardized BI&A practices.

These insights are consistent with BI&A best industry practices and are reflected in some of the metrics used by industry leaders to measure BI&A impact. For example, a global energy

infrastructure company recognized by Data Warehousing Institute (TDWI) Best Practices Award 2017 (Rivera and Delaney 2015; "Winners: TDWI Best Practices Awards 2017" 2017) achieved improved performance through BI&A-enabled reconfiguration of its maintenance capabilities. The specific BI&A application it implemented helped it increase windmill blade availability and reduce preventive maintenance cost at its wind farms by a predicted 50% annually, resulting in stronger bottom line. Similarly, a relatively young company in the virtual network sector, which was able to leverage BI&A investments to achieve improved organizational profitability with a projected $2.6 million increase in revenue by the end of the first year after implementation. In this case, firm performance gains resulted from improvements in the firm's customer billing capability and the resolution of billing errors, which became possible due to the use of BI&A tools and the integration of its 14TB of data into a central storage. Furthermore, consistent with the tenet that the effect of superior BI&A capabilities manifests itself through improvements in ordinary capabilities, investments in BI&A capabilities have been associated with improvements in a variety of metrics, including sales force productivity, cost avoidance, improved response time to customers, improved time-to-market, faster sale closing time, and a variety of supply chain metrics (Biswas and Sen 2016; Jernigan et al. 2016; "Winners: TDWI Best Practices Awards 2013" 2013).

7. Limitations

The results of the study should be considered in the light of several important limitations. First, because the SST conceptualization of dynamic capabilities that informs this research is relatively new, much remains to be learned about the nature of the interaction between sensing, seizing and transforming components. Teece (2007) primarily characterizes the relationship

between these components as sequential, but also notes that some level of tension may exist between them. There is little empirical research upon which to base the selection of one modeling approach over another, however the mediation model is consistent with other theorizing in the dynamic capabilities context (Pavlou and El Sawy 2011; Roberts and Grover 2012; Schreyögg and Kliesch-Eberl 2007). As such, in this study we chose the mediation approach to model the components of dynamic capabilities. However, future research should expand upon the post-hoc analysis reported here and further explore the possibility that sensing, seizing, and transforming operate in parallel, have interaction effects, or represent first-order dimensions of a higher-order construct. Second, this research used a non-probability snowball sample, which is susceptible to selection bias (Atkinson and Flint 2001). Two techniques were employed to address this issue: (1) use of a relatively diverse set of sample seeds (Sadler et al. 2010), and (2) use of multiple gatekeeper access points to improve the characteristics of the sample (Christopoulos 2009). While some have argued that asymptotically unbiased samples are possible no matter how seeds are selected (Salganik and Heckathorn 2004), the use of snowball sampling remains a possible limitation of this work. Third, this study employed perception-based evaluations of functional and financial performance measures. Although common in capabilities and strategic management research (e.g., Chakravarty et al. 2013; Kim et al. 2011), such measures are the self-reported evaluations of the participants involved. Future research that identifies third-party data sources would be useful in confirming the findings of this study. Fourth, the data collected are highly focused on BI&A as it relates to the specific aspects of the sense-seize-transform model. Future research could benefit from expanding the measures to include a broader set of items more traditionally studied in BI&A such as technical readiness, types of decisions/processes for which BI&A was used, and organizational culture in which the

BI&A implemented. Fifth, this study adapted measures for data quality from Wixom and Watson (2001). This scale was chosen because it was (a) from a rigorous and well-cited study, and (b) relatively concise. However, others have argued that data quality is a much more complex, multi-dimensional construct (Wand and Wang 1996). As such, the construct as measured in this study, may not fully capture all relevant features of data quality. While we believe the chosen scale provides an adequate representation of the importance of data quality to BI&A-derived firm performance, future work should explore the influence of individual dimensions of data quality on dynamic capabilities and organizational outcomes. Finally, this study uses a cross-sectional research method. Dynamic capabilities often take a significant time to develop and the effects of those capabilities on organizational performance may occur over time (Helfat et al. 2007; Teece et al. 1997). Longitudinal studies that consider the development of sensing, seizing, and transforming over time would add to our understanding of how the growth of these capabilities influences organizational performance.

8. Conclusions

This study addresses a gap in the scholarly literature by establishing a theoretical framework for the role of BI&A in achieving firm performance that is grounded in an established strategic management theory. We argue that BI&A represents sensing and seizing components of organizational dynamic capabilities. As such, BI&A acts as an enabler of organizational transformations and thus contributes to improved organizational outcomes. The development of BI&A sensing and seizing capabilities relies on well-established managerial processes and sophisticated technical infrastructure. The conceptualization of BI&A as an essential component of dynamic capabilities helps explicate how BI&A contributes to improved organizational

outcomes, answering the call for research on the organizational and strategic uses of BI&A and their impact on firm performance (Jourdan et al. 2008; Sharma et al. 2014). Building on the SST view of dynamic capabilities (Teece 2007), this study demonstrates *how* BI&A enables organizations to sense opportunities and threats and seize those occasions through improved decision making. Further, this research links the use of BI&A to improved organizational outcomes through the transformation of business processes, consistent with the view that the value of IT is derived from its impact on the value generating processes of the firm. Finally, this study demonstrates the relevance of BI&A success factors in extant research to the development of superior BI&A sensing and seizing capabilities. This study contributes to the existing research on BI&A, IS success and firm performance by empirically testing a model which integrates these theoretical perspectives. The results of this research enable both academicians and practitioners to a have a holistic, yet detailed, picture of the organizational impacts of BI&A. In the environment where many organizations reap less-than-satisfactory results from investments in BI&A (Kiron et al. 2011; Phan and Vogel 2010), we hope that this study may serve as normative guidance for practitioners seeking to increase the return on their BI&A investments.

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APPENDIX

Description of Item Development

Items for BI&A Sensing Capability and BI&A Seizing Capability were developed for this study in a multi-step process. First, guided by Teece's conceptualization of sensing and seizing, the first author created a set of initial items. Second, the items for each construct were reviewed by a panel of academic experts in an effort to evaluate the face validity of each scale. This panel consisted of college of business faculty members at a large public university and included four

individuals: a full professor of management, a full professor of business analytics, and full and associate professors of information systems. In addition to identifying a number of minor wording changes, the panel members recommended changes to ensure that the scales adequately capture the multi-dimensional nature of the constructs in question. Consulting with the panel iteratively, the first author revised the initial items in order to address this issue as well as make minor changes to improve the clarity of each item. The initial items and the final items are presented in Table A1. Third, all developmental items went through two rounds of the Q-Sort procedure described by Moore and Benbasat (1991), each round employing a 3-member panel of judges not previously exposed to the items.

In round one, three panel members separately received a randomized set of index cards, each containing an individual survey item. The three judges were asked to sort the items into groups and then provide a construct label for each category (Moore and Benbasat 1991). The results of round one were assessed in two ways. First, the number of categories created by each judge was compared to the number of known constructs to ensure that no unrecognized factors existed within the survey items. In addition, the labels provided by each judge were compared to the construct names and definitions in order to determine if judges could discern the nature of the underlying constructs through an examination of their proposed indicators. Each judge identified the correct number of constructs and produced labels that corresponded well with the research constructs. Second, inter-rater reliability was assessed using the AC1 statistic, a modified version of Fleiss' kappa that accounts for variance due to sampling random raters (Gwet 2008). The resulting value of 0.85, indicates almost perfect agreement among the judges (Landis and Koch 1977).

In round two, three new panel members received randomized index cards containing the survey items as well as one card per construct containing its name and definition. As in round one, judges were asked to categorize each item. However, in this round, the experts were instructed to associate each category with its corresponding construct. The AC1 statistic for this round was 0.74, indicating substantial agreement (Landis and Koch 1977). The high levels of agreement between judges and their ability to easily identify the nature and number of underlying constructs suggested that construct validity had been established (Petter et al. 2007). Thus, no alterations were made based on the outcome of the Q-Sort.

Finally, the complete scale was pilot tested using a sample of MBA students with prior BI&A experience. Results of the pilot suggested adequate reliability and validity, and no additional modifications were made to the scales.

Table A1. Initial versus Final Developmental Scale Items

Construct	Initial Scale	Final Scale	
	Items	Dimension	Items
BI&A Sensing Capability	BI&A allows our company to… 1. sense opportunities and threats 2. identify opportunities for organizational change 3. be more aware of our environment 4. foresee a wide range of actionable options 5. identify alternative ways of doing business	Internal	Our BI&A capabilities allow our company to… 1. detect opportunities for improved efficiency or effectiveness in the company 2. sense the need to enhance the way our business works 3. be more aware of internal opportunities and threats 4. identify inefficiencies in existing business processes

	6. detect opportunities for improved efficiency or effectiveness in the organization clearly see what needs to change	External	Our BI&A capabilities allow our company to… 1. sense opportunities and threats in the environment 2. identify opportunities for organizational change based on market conditions 3. be more aware of our environment 4. foresee a wide range of actionable options based on its surroundings
BI&A Seizing Capability	When an opportunity or threat is identified, our company can … 1. Quickly determine a course of action 2. Formulate an effective plan 3. Create a strategy to capitalize on the situation 4. Develop an action plan 5. Clearly communicate a plan of action 6. Make us aware of upcoming changes 7. Get relevant stakeholders on the same page 8. Build consensus for a course of action 9. Be decisive about how to act 10. Make sound decisions about which course of action to pursue 11. Determine the best course of action	Shared Understanding	When an opportunity or threat is identified using BI&A, our company can… 1. develop agreement among relevant stakeholders about the response 2. have relevant stakeholders agree on a response 3. get relevant stakeholders on the same page regarding the response 4. build consensus among relevant stakeholders for the response
		Planning	When an opportunity or threat is identified using BI&A, our company can… 1. develop a sound response plan 2. formulate an effective plan 3. create a strategy to capitalize on the situation 4. develop a viable action plan

	12. Decide on the appropriate response	Decision Making	When an opportunity or threat is identified using BI&A, our company can… 1. be decisive about the course of action 2. make effective decisions about which course of action to pursue 3. quickly decide on the best course of action 4. decide on the appropriate course of action

Details of Exploratory Factor Analysis

All measurement items were entered into an exploratory factor analysis (EFA). The factors were extracted using principle component analysis with varimax rotation. The initial EFA employed Kaiser's criterion as the basis for factor extraction which states that factors with Eigenvalues greater than one should be retained (Kaiser 1960). Although 13 factors were expected due to the presence of 13 first-order constructs represented in the data, the initial EFA produced 14 factors. In addition, the EFA revealed that the dimensions of BI&A seizing capability (shared understanding, decision making, and planning) loaded together on a single factor. After cross-loading items (FinPerf7 and ManCap3) and items which failed to meet the 0.50 standard for practical significance (Hair et al. 2010) (ManCap2 and ManCap4) were removed, the resulting EFA revealed a tendency for the dimensions of BI&A sensing capability (internal sensing and external sensing) to load together as well. Because correlations between first-order factors are common and may be due to the presence of a second-order factor (Doll et al. 1994; Tanaka and Huba 1984), a final EFA was run and 10 factors were extracted (8 first-order constructs, plus the combined dimensions of BI&A sensing capability, and the combined

dimensions of BI&A seizing capability). The resulting factor analysis is presented in Table A2 (factor loadings less than 0.40 are suppressed).

Table A2. Exploratory Factor Analysis

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10
ProdExp1	0.756									
ProdExp2	0.710									
ProdExp3	0.730									
ProdExp4	0.585									
ConExp1		0.811								
ConExp2		0.830								
ConExp3		0.808								
ConExp4		0.655								
ManCap1			0.611							
ManCap5			0.705							
ManCap6			0.717							
ManCap7			0.754							
ManCap8			0.768							
DataQual1				0.843						
DataQual2				0.670						
DataQual3				0.848						
DataQual4				0.744						
SysQual1					0.618					
SysQual2					0.602					
SysQual3					0.752					
SysQual4					0.663					
SenInt1						0.531				
SenInt2						0.652				
SenInt3						0.676				
SenInt4						0.628				
SenExt1						0.732				
SenExt2						0.708				
SenExt3						0.790				
SenExt4						0.681				
SharUnd1							0.808			
SharUnd2							0.848			
SharUnd3							0.777			
SharUnd4							0.778			
Plan1							0.749			
Plan2							0.724			
Plan3							0.710			
Plan4							0.648			
Dec1							0.655			
Dec2							0.713			
Dec3							0.724			
Dec4							0.582			
BPCCap1								0.798		
BPCCap2								0.837		
BPCCap3								0.796		
BPCCap4								0.641		
BPCCap5								0.695		

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10
BPCCap6								0.711		
FuncPerf1									0.722	
FuncPerf2									0.708	
FuncPerf3									0.756	
FuncPerf4									0.592	
FuncPerf5									0.702	
FuncPerf6									0.725	
FirmPerf1										0.707
FirmPerf2										0.826
FirmPerf3										0.760
FirmPerf4										0.816
FirmPerf5										0.759
FirmPerf6										0.705
FirmPerf8										0.692

ProdExp = Producer Expertise; ConExp = Consumer Expertise; ManCap = Management Capability; DataQual = Data Quality; SysQual = System Quality; SenInt = Internal Sensing; SenExt = External Sensing; SharUnd = Shared Understanding; Plan = Planning; Dec = Decision Making; BPCCap = Business Process Change Capability; FuncPerf = Functional Performance; FirmPerf = Firm Performance

Final Survey Instrument

The constructs, questionnaire items, and sources for previously validated scales are presented in Table A3 below. The questionnaire was presented in electronic format and all construct items were measured on a 5-point Likert scale.

Table A3. Survey Instrument Details

Construct	Dimension	Item	Source
BI&A Personnel Expertise	Producer Expertise	Individuals in our company responsible for producing BI&A outputs… 1. have strong technical BI&A skills 2. have adequate knowledge about BI&A 3. have BI&A skills comparable with the best in the industry 4. have a good understanding of the possible benefits of BI&A applications	(Chakravarty et al. 2013)

Construct	Dimension	Item	Source
	Consumer Expertise	Individuals in our company responsible for using BI&A outputs… 1. have strong technical BI&A skills 2. have adequate knowledge about BI&A 3. have BI&A skills comparable with the best in the industry 4. have a good understanding of the possible benefits of BI&A applications	(Chakravarty et al. 2013)
BI&A Management Capability		Our BI&A management… 1. encourages standardization of our BI&A development processes 2. delivers BI&A projects on time* 3. allocates sufficient resources to BI&A* 4. ensures our BI&A capabilities are scalable* 5. encourages the use of BI&A within our company 6. focuses on user satisfaction with BI&A capabilities 7. promotes the use of BI&A within our company 8. champions the use of BI&A within our company	(Wieder et al. 2012; Wixom and Watson 2001)
BI&A Technical Infrastructure Quality	Data Quality	The data underlying our BI&A solution are… 1. accurate 2. comprehensive 3. correct 4. consistent	(Wixom and Watson 2001)
	System Quality	Our company's BI&A solutions… 1. can flexibly adjust to new demands or conditions 2. effectively integrate data from systems servicing different functional areas 3. are versatile in addressing data needs as they arise 4. effectively integrate data from a variety of data sources within the company	(Wixom and Watson 2001)

Construct	Dimension	Item	Source
BI&A Sensing Capability	Sensing Internal	Our BI&A capabilities allow our company to… 1. detect opportunities for improved efficiency or effectiveness in the company 2. sense the need to enhance the way our business works 3. be more aware of internal opportunities and threats 4. identify inefficiencies in existing business processes	Developmental
	Sensing External	Our BI&A capabilities allow our company to… 1. sense opportunities and threats in the environment 2. identify opportunities for organizational change based on market conditions 3. be more aware of our environment 4. foresee a wide range of actionable options based on its surroundings	Developmental
BI&A Seizing Capability	Shared Understanding	When an opportunity or threat is identified using BI&A, our company can… 1. develop agreement among relevant stakeholders about the response 2. have relevant stakeholders agree on a response 3. get relevant stakeholders on the same page regarding the response 4. build consensus among relevant stakeholders for the response	Developmental
	Planning	When an opportunity or threat is identified using BI&A, our company can… 1. develop a sound response plan 2. formulate an effective plan 3. create a strategy to capitalize on the situation 4. develop a viable action plan	Developmental
	Decision Making	When an opportunity or threat is identified using BI&A, our company can… 1. be decisive about the course of action 2. make effective decisions about which course of action to pursue 3. quickly decide on the best course of action 4. decide on the appropriate course of action	Developmental

Construct	Dimension	Item	Source
Business Process Change Capability		When responding to opportunities and threats, our company can… 1. change its business processes in a timely manner 2. rapidly adapt its business processes to competitive changes 3. quickly reallocate resources among business processes 4. effectively combine existing resources within business processes 5. effectively change business processes 6. effectively reconfigure business processes	(Lee et al. 2012; Protogerou et al. 2011)
Functional Performance		Our company's business process performance is better than our rivals' in terms of… 1. Efficiency 2. Productivity 3. Cost of effective decision making 4. Operational cost 5. Quality of product or service outcomes 6. General performance	(Drnevich and Kriauciunas 2011; Elbashir et al. 2008)
Firm Performance		Our company's current financial performance is better than our rivals' in terms of… 1. Return on Investment 2. Sales 3. Profit 4. Growth 5. General success 6. Return on assets 7. Market share* 8. Competitive position	(Arend 2012; Chakravarty et al. 2013)

* Dropped from study during instrument validation

Measurement Model Details

Table A4. Measurement Model Summary

Item	Standardized Loading	Cronbach's Alpha	AVE	ProdExp	ConExp	ManCap	DataQual	SysQual	SenInt	SenExt	SharUnd	Plan	Dec	BPCCap	FuncPerf	FirmPerf
ProdExp1	0.898	0.877	0.732	0.855												
ProdExp2	0.843															
ProdExp3	0.888															
ProdExp4	0.789															
ConExp1	0.822	0.853	0.696	0.483	0.834											
ConExp2	0.875															
ConExp3	0.863															
ConExp4	0.772															
ManCap1	0.645	0.879	0.679	0.527	0.248	0.824										
ManCap5	0.852															
ManCap6	0.808															
ManCap7	0.898															
ManCap8	0.892															
DataQual1	0.915	0.884	0.745	0.345	0.265	0.318	0.863									
DataQual2	0.785															
DataQual3	0.900															
DataQual4	0.846															
SysQual1	0.816	0.892	0.757	0.552	0.293	0.499	0.476	0.870								
SysQual2	0.881															
SysQual3	0.916															
SysQual4	0.864															
SenInt1	0.785	0.846	0.685	0.428	0.279	0.520	0.390	0.533	0.828							
SenInt2	0.844															
SenInt3	0.825															
SenInt4	0.854															
SenExt1	0.880	0.872	0.723	0.368	0.230	0.525	0.355	0.429	0.699	0.850						
SenExt2	0.820															
SenExt3	0.854															
SenExt4	0.847															
SharUnd1	0.898	0.935	0.837	0.313	0.186	0.461	0.351	0.458	0.507	0.497	0.915					
SharUnd2	0.931															
SharUnd3	0.923															

Item	Standardized Loading	Cronbach's Alpha	AVE	ProdExp	ConExp	ManCap	DataQual	SysQual	SenInt	SenExt	SharUnd	Plan	Dec	BPCCap	FuncPerf	FirmPerf
SharUnd4	0.907															
Plan1	0.885	0.932	0.831	0.463	0.341	0.589	0.388	0.463	0.581	0.587	0.768	0.911				
Plan2	0.940															
Plan3	0.914															
Plan4	0.906															
Dec1	0.891	0.927	0.821	0.460	0.362	0.506	0.476	0.555	0.554	0.506	0.736	0.812	0.906			
Dec2	0.934															
Dec3	0.906															
Dec4	0.894															
BPCCap1	0.813	0.904	0.677	0.230	0.265	0.275	0.355	0.441	0.364	0.315	0.440	0.473	0.526	0.823		
BPCCap2	0.832															
BPCCap3	0.844															
BPCCap4	0.773															
BPCCap5	0.832															
BPCCap6	0.840															
FuncPerf1	0.850	0.913	0.699	0.281	0.296	0.231	0.448	0.465	0.402	0.296	0.334	0.387	0.506	0.449	0.836	
FuncPerf2	0.874															
FuncPerf3	0.843															
FuncPerf4	0.751															
FuncPerf5	0.801															
FuncPerf6	0.891															
FirmPerf1	0.829	0.921	0.687	0.155	0.265	0.161	0.306	0.345	0.394	0.304	0.331	0.410	0.452	0.431	0.668	0.824
FirmPerf2	0.835															
FirmPerf3	0.815															
FirmPerf4	0.800															
FirmPerf5	0.839															
FirmPerf6	0.844															
FirmPerf8	0.803															

Numbers on the diagonal are the square root of the AVE

ProdExp = Producer Expertise; ConExp = Consumer Expertise; ManCap = Management Capability; DataQual = Data Quality; SysQual = System Quality; SenInt = Internal Sensing; SenExt = External Sensing; SharUnd = Shared Understanding; Plan = Planning; Dec = Decision Making; BPCCap = Business Process Change Capability; FuncPerf = Functional Performance; FirmPerf = Firm Performance