Business Intelligence and Analytics: A Capabilities Dynamization View

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Abstract

Business Intelligence and Analytics (BI&A) is an important topic of IS research with significant implications for practitioners. However, while substantial research exists related to BI&A, it often fails to bridge the gap between normative specifications on BI&A use and improved business outcomes such as the development of competitive advantage. Building on the dynamic capabilities perspective, this paper proposes BI&A as a mechanism for capability monitoring, and describes how it may enable capability dynamization. In light of this view, we highlight five core internal components of BI&A: (1) collection and management of capability practices data, (2) collection and management of environmental data, (3) analysis of environmental data and identification of discontinuities in the environment, (4) identification of capability maladjustments, and (5) producing a request for change. We then discuss the implications of the capability dynamization view on BI&A design, implementation, and management.

Keywords

Business intelligence, business analytics, dynamic capabilities, capability monitoring.

Introduction

Overwhelmed with the growing volumes of data that are continuously generated and stored in corporate repositories, organizations are spending considerable resources on managing and making sense of what came to be referred to as “big data.” According to a Gartner estimation, the need to support big data will result in the creation of over four million IT jobs worldwide by 2015 (Gartner 2012). Business analytics holds the promise of harnessing the power of big data and is heralded as a path to competitive advantage (Davenport 2006; Kiron et al. 2011). According to the results of 2010 Global CIO Survey of 2500 CIOs by IBM, 89 percent of the respondents identified business intelligence and analytics as a part of their visionary strategic initiatives (IBM Corporation 2012). Investments in analytics and business intelligence have topped the list of IT investments from 2009 through 2013 according to the annual SIM IT Trends Study (Kappelman et al. 2013). According to an MIT Sloan Management Report, “fifty eight percent of organizations now apply analytics to gain competitive advantage within their market and industries” (Kiron et al. 2011, p. 4). Business analytics is heralded as a solution for identifying strategic business opportunities and is critical to improving business agility and gaining competitive advantage. With business agility identified as the second most important IT management concern (Kappelman et al. 2013), investments in analytics and business intelligence are expected to remain at the top of organizational priorities lists.

Business Intelligence and Analytics (BI&A) have been identified as important areas of academic research (Sidorova et al. 2013), with big data analytics defined as a related field (Chen et al. 2012). Significant research has been focused on technical issues associated with the management of big data, as well as with issues surrounding implementation of business intelligence and business analytics initiatives. Although alignment of IT with business was identified as the most important IT management concern by the SIM IT Trends Study.

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highly valuable, such research largely avoids addressing the issue of how analytics can help translate big data into a competitive advantage. Here we attempt to fill this conceptual gap by proposing a conceptualization of BI&A that is informed by the dynamic capabilities perspective (Eisenhardt and Martin 2000; Teece et al. 1997; Zahra et al. 2006). Specifically, we propose that BI&A can be conceptualized as a capability monitoring mechanism, and be viewed as an integral element of capability dynamization.

The rest of the paper is organized as follows: We begin by defining business intelligence and business analytics and illustrate the conceptual gap between their use and the achievement of competitive advantage. Next we describe dynamic capabilities and discuss approaches to capability dynamization. We then demonstrate how BI&A can be used for capability monitoring and describe several important implications associated with this view. Finally we conclude the paper and discuss its contribution to the IS and strategic management literature.

Defining Business Intelligence and Business Analytics

Big data, as well as the opportunities and challenges it presents, continues to motivate research into BI&A (MISQ n.d.). While the literature widely recognizes business intelligence and business analytics as important and related topics, their definitions and the exact nature of their relationship are less well defined. Business intelligence (BI) is often viewed as both a process and product (Jourdan et al. 2008). The process of BI encompasses the procedures and tools used to develop information, while the product (information) is intended to enable decision making. Precise definitions of BI vary but many espouse the “umbrella view” (Turban et al. 2011) in which BI represents a collection of information-management technologies combined with information-seeking activities. Negash (2004), for instance, defines BI systems in terms of their ability to “combine data gathering, data storage, and knowledge management with analytical tools to present complex internal and competitive information to planners and decision makers” (p. 178). In the umbrella view, business analytics (BA) is seen as a tool for the identification and development of information and one of several components which comprise BI. Trkman et al. (2010) define BA as the “application of various advanced analytic techniques to data to answer questions or solve problems” (p. 318). Such definitions highlight the analytical nature of BA approaches and encompass procedures such as predictive modeling and data mining (Turban et al. 2011). Other definitions focus instead on the outcomes of BA, suggesting that it allows the discovery of “insights that drive action and deliver better business outcomes.” (IBM Corporation 2012, p. 4). With the rise of big data, many authors have put increasing emphasis on analytics as a mechanism to cope with the increasing volume, velocity, and variety of data within organizations, leading to the use of BI&A as a unified term (Chen et al. 2012). Despite the term “competitive advantage” featuring prominently in BI&A publications (Chen et al. 2012), the extant literature on BI&A often fails to connect normative specifications on BI&A use with improved business outcomes. In a review of BI&A literature, Jourdan et al. (2008) classify research dealing with BI&A strategy (how to apply BI&A) separately from research dealing with BI&A benefits (improved financial performance), illustrating the separation between these topics. Instead, BI&A research is often centered on technology and architecture, algorithms, or factors related to success. The technology and architecture research stream focuses on specific elements of the various technologies which comprise BI&A and provide architectural guidance (e.g., Chaudhuri et al. 2011; Mircea et al. 2011). Alternatively, a significant portion of the BI&A literature is devoted to the development, evaluation, and application of various algorithms and analytical techniques (Sidorova et al. 2013). Finally, existing BI&A research also focuses heavily on the factors related to success. Such studies often evaluate critical success factors (e.g., Isik et al. 2011, 2013; Yeoh and Koronios 2010), maturity (e.g., Popović et al. 2012), or similar subjects in order to guide the implementation and use of BI&A. While each of these research streams contributes to the effective use of BI&A, there is conceptual gap as to how BI&A can be leveraged for competitive advantage. It is this gap which we seek to address in the remainder of this paper.

Dynamic Capabilities: Key Conceptualizations

The view of competitive advantage based on dynamic capabilities emerged in 1990s as an approach to understanding how and why competitive advantage is created by some firms “in regimes of rapid change” (Teece et al. 1997, p. 509). The dynamic capabilities approach builds on the resource-based perspective
The resource based view suggests that competitive advantage is a result of firms possessing heterogeneous resources and capabilities and encourages organizational acquisition and development of unique, valuable, and scarce resources, including skills, technologies, and know-how. The dynamic capabilities perspective extends the resource based view by emphasizing the importance of organizational ability to renew and reconfigure organizational resources in response to rapid changes in the environment (Teece et al. 1997).

In their seminal paper, Teece and his colleagues define dynamic capabilities as “the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” (Teece et al. 1997, p. 516). Dynamic capabilities are distinct from organizational resources, which include firm-specific assets, as well as from organizational competences and capabilities, which include organizational structures, routines and processes (Teece et al. 1997). Subsequent research on dynamic capabilities is characterized by inconsistencies in how dynamic capabilities are defined and how the distinction between dynamic and ordinary (substantive) capabilities is conceptualized (Zahra et al. 2006). Two aspects of the dynamic capabilities definition are of particular relevance to our discussion, the distinction and the relationship between ordinary and dynamic capabilities and the scope of dynamic capabilities.

The distinction and the relationship between dynamic and ordinary (substantive) capabilities are implied, but not clearly articulated in the early conceptualizations of dynamic capabilities (Eisenhardt and Martin 2000; Helfat 1997; Teece et al. 1997). Such definitions, however, underscore the focus of dynamic capabilities on change and resource reconfiguration, as opposed to continuity and resource exploitation. For example, Eisenhardt and Martin (2000) define dynamic capabilities as “[t]he firm’s processes that use resources—specifically the processes to integrate, reconfigure, gain and release resources—to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die” (p. 1107). Winter (2003) draws an explicit distinction between ordinary and dynamic capabilities. Ordinary capabilities are described as “how-we-earn-a-living-now” capabilities (p. 992), and dynamic capabilities are viewed as higher-order capabilities, which are directed at governing the change in ordinary capabilities. Two things are notable about Winter’s conceptualization of dynamic capabilities: First, it does not preclude, and even prescribes, a certain degree of routinization of dynamic capabilities. Second, it implies that capabilities can be viewed as a hierarchical structure, with zero-level capabilities constituting the base of the pyramid and ad-hoc problem solving representing the top. The layers in-between represent different levels of dynamic capabilities directed at governing or effecting change in the subordinate layer. Winter (2003) cautions that developing, maintaining, and using dynamic capabilities is costly, and the benefits depend on the availability of “opportunities for competitively significant change” (p. 994).

Building on Winter’s conceptualization, Zahra and his colleagues define dynamic capabilities as “the ability of the firm to reconfigure a firm’s resources and routines in the manner envisioned and deemed appropriate by the firm’s principal decision maker(s)” (2006, p.924). This definition, however, has two marked distinctions with that of Winter (2003). First, the definition of the dynamic capabilities is tied to the organizational ability to change, not to its ability to change successfully, i.e. to improve its competitive position or financial performance as a result of the change. The other distinction is that Zahra’s definition assigns the responsibility for initiating the change and identifying the direction of change to a principal decision maker.

Zahra’s definition of dynamic capabilities, although sound from semantic point of view, is practically problematic. By assigning the responsibility for initiating a change to a decision maker, Zahra’s definition restricts the scope of dynamic capabilities to organizational ability to react to a request for change. As such, the definition intentionally excludes organizational abilities to monitor the environment and to identify strategically significant opportunities for change. Yet, the importance of knowing when to change is widely acknowledged in the dynamic capabilities literature. Teece and his colleagues caution against low pay-off change and emphasize the importance of environmental scanning:

*Change is costly and so firms must develop processes to minimize low pay-off change. The ability to calibrate the requirements for change and to effectuate the necessary adjustments would appear to depend on the ability to scan the environment, to*
evaluate markets and competitors, and to quickly accomplish reconfiguration and transformation ahead of competition (Teece et al. 1997, p. 521).

Environmental scanning and identification of opportunities for change are also considered to be critical components of dynamic capabilities as conceptualized by Schreyögg and Kliesch-Eberl (2007).

Dynamic capabilities perspective has been applied to study the role of IT in business strategy. IT is considered critical for firms’ ability to reconfigure itself at a lower cost, and to help identify opportunities for change (Drnevich and Croson 2013). In line with the dynamic capabilities perspective, IT investments are proposed to have a positive effect on entrepreneurial and adaptive agility (Chakravarty et al. 2013). IT capabilities, including IT management capabilities, IT personnel experience, and IT infrastructure flexibility are posited to be positively related to the firm’s process-oriented dynamic capabilities. In the following sections we extend the extant research and examine the role of a BI&A in capability dynamization.

**Approaches to Capability Dynamization**

Approaches to capability dynamization have been classified into three broad categories: the integrative approach, the innovation routines approach, and the radical dynamization approach (Schreyögg and Kliesch-Eberl 2007). The integrative approach advocates incorporating learning and transformation dimensions into the stable routine, thus combining the stable and the dynamic dimensions of organizational capabilities (Teece et al. 1997). This approach has been criticized for underrating the contradictory nature of the two dimensions and for either compromising the exploitation potential of existing capabilities or the exploration potential associated with having new and improved routines (Schreyögg and Kliesch-Eberl 2007). Recognizing the difficulty of resolving the internal conflict between the need for stabilization and dynamization within organizational capabilities, the innovation routines approach advocates the creation of higher order routines that specialize in innovation and are designed for overcoming the rigidity of ordinary organizational capabilities (Winter 2003). The critics of this approach posit that even innovation routines are likely to fall into the rigidity trap, and thus become an impediment to adaptation in the face of substantial environmental changes (Schreyögg and Kliesch-Eberl 2007). The radical dynamization approach recognizes the need for different types of dynamic capabilities in relatively stable and highly volatile environments. Whereas dynamic capabilities conceptualized as relatively routine innovation processes are deemed appropriate for relatively stable environments, highly volatile environments call for dynamic capabilities which are “simple (not complicated), experiential (not analytic), and iterative (not linear) processes [...] in the continuously unstable state of slipping into either too much or too little structure” (Eisenhardt and Martin 2000, p. 1113). The radical dynamization approach has been criticized for blurring the line between capabilities and ad-hoc problem solving (Schreyögg and Kliesch-Eberl 2007; Winter 2003).

The dual process approach to capability dynamization is proposed as a way to resolve an apparent disparity between “the postulation of continuous renewal on the one hand and the patterned architecture of organizational capabilities on the other” (Schreyögg and Kliesch-Eberl 2007, p. 914). The dual process model of capability dynamization suggests that organization should engage in capability monitoring activity that would reflect on the current operational capabilities, as well as the external environment, and suggest changes to operational routines.

*Dynamicization through compensation means firstly monitoring the system’s capabilities, its evolvement, its usage, its effects inside and outside the organization, as well as critical issues and discontinuities in the system’s environment. By continuously observing (scanning) the capability landscape, its practices, recursion, blinders, potential failures and maladjustments can be identified— preferably at a very early stage. By becoming aware of these critical signals the issue of potential change requirements is put on the agenda of organizational decision making. This system presses itself to make a decision as to whether or not the approved problem-solving architecture should be abandoned (Schreyögg and Kliesch-Eberl 2007).*

In contrast to the conceptualization of dynamic capabilities as merely the ability to reconfigure organizational routines and processes in response to a request for change (Zahra et al. 2006), the dual process approach to capability dynamization puts an emphasis on capability monitoring and the ability to...
recognize the need for change and the direction for such change. Although the two conceptualizations appear to be contradictory, they can also be viewed as complementary to the critical elements of capability dynamization: the ability to recognize the need for change and the ability to successfully execute the change. The two components are consistent with the two-dimensional view of organizational agility, which encompasses entrepreneurial agility and adaptive agility (Chakravarty et al. 2013). By emphasizing the importance of capability monitoring the dual process approach to capability dynamization offers a conceptual framework for theorizing the strategic role of business intelligence and analytics.

The Capability Dynamization View of BI&A

The dual process approach to capability dynamization suggests that organizational capabilities need to be continuously monitored and their relevance to the changing internal and external environment needs to be constantly assessed. As a result of such monitoring, opportunities for change are identified and a request for change is produced (Schreyögg and Kliesch-Eberl 2007). BI&A can be conceptualized as a capability monitoring mechanism, and this conceptualization has a potential for highlighting critical aspects of BI&A design and implementation. Building on the description of capability monitoring by Schreyogg and Kliesch, capability monitoring can be delineated into (1) gathering data about the capability itself, as well as about internal and external environments; (2) analyzing the environmental data in order to identify potential discontinuities in the environment; (3) analyzing the capability data in relation to the identified environmental discontinuities to detect maladjustments and blind spots; and (4) producing a change recommendation that would help reconfigure the capability for better alignment with the external environment. This, in essence, defines the place, the goal and the business requirements for BI&A.

Figure 1. The Capability Dynamization View of BI&A

Figure 1 illustrates the role of BI&A as a capability monitoring mechanism. Consistent with the dual process model of capability dynamization, the capability dynamization view of BI&A distinguishes between the operational level (capability practices) and the observational level (capability monitoring). At the operational level, capabilities are enacted through the execution of business processes, which may
range from standardized to highly knowledge intensive (Dalmaris et al. 2007; Trkman 2010). Capability monitoring is implemented via BI&A. Capability practices generate data, which, when captured, are used as an input into capability monitoring via BI&A. Analysis of changes in the external environment is a key component of capability monitoring. Therefore, data from external sources constitute another input into BI&A. The importance of internal and external data sources has been recognized in extant research (Isik et al. 2011), thus, on the input side, the conceptualization of BI&A as capability monitoring is consistent with extant BI&A research.

Consistent with the dual process model of capability dynamization (Schreyögg and Kliesch-Eberl 2007), the BI&A capability dynamization model defines requests for change in existing business processes and/or structures as the key output of BI&A. Requests for change are produced intermittently and not as a result of each round of capability monitoring activities. Implementation of requests for change results a modified capability, such as a new version of a business process. Such renewed capability continues to be monitored through BI&A. Business Process Analytics, which is a component of most Business Process Management Systems (BPMS), provides a case in point of capability monitoring. Process analytics refers to a family of methods and tools that are applied to process and event data which is generated or captured by BPMS during the execution of process instances. Process analytics helps identify events that can result in changes to business process performance, and thus allows organization to react to such events in a timely manner (zur Muehlen and Shapiro 2010).

The capability dynamization view also highlights five core internal components of BI&A: (1) collection and management of capability practices data, (2) collection and management of environmental data, (3) analysis of environmental data and identification of discontinuities in the environment, (4) identification of capability maladjustments, and (5) producing a request for change. To date, BI&A research had primarily focused on the first three components. Factors related to managing internal data for future decision making has been widely addressed in data warehouse design and implementation research, as well as in business intelligence research (Isik et al. 2013; Ramakrishnan et al. 2012; Wixom and Todd 2005). Related to environmental monitoring, the importance of providing high quality external information has also been recognized (Isik et al. 2011). Research on various analytic technics and approaches, including text mining, web analytics, network and mobile analytics is emerging (Chen et al. 2012). Such research is instrumental in addressing the issue of environmental analysis and identification of discontinuities.

The dynamization view points to two additional aspects of BI&A that have been largely overlooked in extant research: identification of capability maladjustments and the development of requests for change. Capability maladjustments identification requires the interpretation of the results of data analysis in the light of current capability practices. Producing request for change involves determining whether the identified maladjustments are significant enough to warrant capability disruption and associated organizational costs (Winter 2003). Accurate maladjustment identification and producing justified requests for change are critical to harnessing the strategic value of BI&A.

In sum, the capability dynamization view paints a full picture of how strategic value can be delivered through BI&A, and provides a more complete view of BI&A activities. Conceptualizing BI&A as a capability monitoring mechanism has several important implications for the design and architecture of BI&A systems, as well as for BI&A process and governance. These are discussed next.

**Implications of BI&A as capability monitoring**

**Capability-focused design of BI&A**

The capability dynamization view of BI&A implies that, on one hand, capability monitoring via BI&A need to be focused on specific organizational capabilities, and, on the other hand involves monitoring of the internal and external environments. This puts conflicting demands on BI&A architecture. The five elements of BI&A outlined herein point to potential approaches towards BI&A architecture design. Centralization of internal and external data collection management, as well of identification of discontinuities in the internal and external environments offers synergistic benefits. However, identification of maladjustments and corresponding requests for change require capability specific expertise and focus.
The need for having capability specific BI&A activities raises an issue of resource allocation. It is widely acknowledged that capability dynamization is expensive and needs to be implemented selectively (Teece et al. 1997; Winter 2003). Winter (2003) warns that having a dynamic capability and never exercising it equates to carrying a cost burden without a respective payoff. On the other hand, an aggressive search for occasions to change “in a deliberate effort to exercise the dynamic capability” can results in costs and disruptions that outweigh the strategic benefits of the capability renewal (p. 993). This implies that, in allocation of BI&A resources, one must consider the likelihood of the need for change in underlying capabilities, as well as the costs and benefits of change.

Assessment of BI&A success

The capability dynamization view suggests that requests for change in existing capabilities are the key outcomes of BI&A. This is a marked departure from existing conceptualizations of BI&A which view managerial insight as its goal. In the light of the capability dynamization view of BI&A, success of BI&A initiatives needs to be measured by the production of requests for change, the extent to which the requests for change are acted upon, and by the outcomes of the resultant changes. This requires that information on how requests for change are implemented and whether the results of such changes are positive or negative, is fed back into the BI&A process. Understanding the role of feedback in the management of BI&A activities can be viewed as a fruitful direction for future research.

Alignment with change management

The proposed view of BI&A as a capability monitoring mechanism implies that requests for change are implemented. Such implementation, however, is not trivial and requires significant change management capabilities, also referred to as adaptive agility (Chakravarty et al. 2013; Zahra et al. 2006). This calls for a close alignment between BI&A and organizational change management practices. Business Process Management (BPM) has emerged as a holistic approach to delivering business value through the improvement of organizational effectiveness and agility (Hammer 2010). As such BPM is related to organizational ability to successfully execute the change, which is complementary to the use of BI&A for capability dynamization. Although process analytics and process mining have been acknowledged as an important element of both BI&A and BPM (Chen et al. 2012; zur Muehlen and Shapiro 2009), more extensive research on the intersection of BI&A and BPM is necessary.

Conclusions

Building on the dynamic capabilities perspective, this paper proposes a capability dynamization view of BI&A. BI&A is conceptualized as a capability monitoring element of capability dynamization, and its goal is defined as production of requests for change to existing organizational capabilities. The paper outlines five core components of BI&A and highlights implications of the proposed view for BI&A design, implementation, and management. The proposed conceptualization makes two important contributions. From the IS research point of view, the proposed conceptualization highlights the theoretical link between BI&A and competitive advantage. From the strategic management perspective, proposing BI&A as a practical instantiation of capability monitoring offers a path for strategy implementation and helps highlight architectural and governance issues related to capability dynamization.

References


