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How to improve firm performance using big data analytics capability and business strategy alignment?

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ABSTRACT

The recent interest in big data has led many companies to develop big data analytics capability (BDAC) in order to enhance firm performance (FPER). However, BDAC pays off for some companies but not for others. It appears that very few have achieved a big impact through big data. To address this challenge, this study proposes a BDAC model drawing on the resource-based theory (RBT) and the entanglement view of sociomaterialism. The findings show BDAC as a hierarchical model, which consists of three primary dimensions (i.e., management, technology, and talent capability) and 11 subdimensions (i.e., planning, investment, coordination, control, connectivity, compatibility, modularity, technology management knowledge, technical knowledge, business knowledge and relational knowledge). The findings from two Delphi studies and 152 online surveys of business analysts in the U.S. confirm the value of the entanglement conceptualization of the higher-order BDAC model and its impact on FPER. The results also illuminate the significant moderating impact of analytics capability–business strategy alignment on the BDAC–FPER relationship.

1. Introduction

Firms are increasingly challenged by "Big Data", which has emerged as an exciting frontier of productivity and opportunity in the last few years. Big data analytics capability (BDAC) is widely considered to transform the way in which firms do business (Barton and Court, 2012; Davenport and Harris, 2007a). Recent literature identifies that BDAC has "the potential to transform management theory and practice"(George et al., 2014, p. 325), it is the "next big thing in innovation" (Gobble, 2013, p. 64); and "the fourth paradigm of science" (Strawn, 2012, p. 34); or the next "management revolution" (McAfee and Brynjolfsson, 2012). The incessant growth in worldwide BDAC investment continues as firms search for sustained competitive advantage. These investments to leverage BDAC were around US$2.1 trillion in 2013 (Lunden, 2013), and are expected to be about US$3.8 trillion in 2014 (Gartner, 2014).

A recent study by Accenture and General Electric (Columbus, 2014a) reports that, "87% of enterprises believe Big Data analytics will redefine the competitive landscape of their industries within the next three years. 89% believe that companies that do not adopt a Big Data analytics strategy in the next year risk losing market share and momentum". Yet, investment in big data still poses a lot of challenges due to the missing link between analytics capabilities and firm performance. Although analytics have become more mainstream for firms, the steep growth curve of performance using analytics is flattening out (Kiron et al., 2014). Some scholars go so far as to suggest that the investment in BDAC is a myth, which needs to show productivity by reflecting innovative capability and improved firm performance (Manyika et al., 2011). Motivated by this debate, this study aims to examine the role of BDAC in a big data environment. The notion of BDAC, at its core, illuminates the importance of leveraging management, technology and talent capabilities.

Drawing on the resource-based theory (RBT), BDAC is broadly defined as the distinctive capability of firms in setting the optimal

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price, detecting quality problems, deciding the lowest possible level of inventory or, identifying loyal and profitable customers in big data environment (Davenport and Harris, 2007a). This research also views BDAC from the sociomaterialism perspective because it is based on a delicate mixture of management, talent and technology (Kim et al., 2012; Orlikowski and Scott, 2008). Sociomaterialism presents a balanced view by inextricably interlinking and enacting management, technology, and human dimensions because social and material perspectives are inseparable in organization research (Orlikowski, 2007). Thus, based on the sociomaterialism perspective, this research presents an entanglement conceptualization of three BDAC dimensions (i.e., management, technology, and human) that highlights the importance of the complementarities between them for high level operational efficiency and effectiveness for improved performance and sustained competitive advantage.

The existing research largely focuses on anecdotal evidence in proposing the relationship between BDAC and firm performance (FPER) (Agarwal and Dhar, 2014; Mithas et al., 2013). Despite the strong appeal of the concept, empirical evidence about how BDAC contributes to superior FPER is lacking (Abbasi et al., 2016; Davenport et al., 2012). Thus, drawing on the theoretical lenses of the RBT, IT capability and the sociomaterialism perspective, this study addresses the following research questions: "what are the building blocks of BDAC?" "how is it shaped and strengthened at a firm?" and "what are its effects on firm performance?" Previous research also highlights the importance of analytics capability–business strategy alignment (ACBSA) in big data environment, which is defined as the extent to which analytics strategies are aligned with the overall business strategy of the organization (Agarwal and Dhar, 2014; McAfee and Brynjolfsson, 2012). Based on the RBT, some scholars propose that internal business processes could be important factors linking BDAC and firm performance (FPER) (Dehning and Richardson, 2002; Melville et al., 2004). As ACBSA is one of the important aspects of internal business processes in the organization's response to market changes, (Davenport and Harris, 2007a), this study is motivated to explore the role of ACBSA by answering the research question: "does ACBSA play a moderating role in the relationship between BDAC and FPER?"

To address the research questions, this research develops and validates a BDAC model, and tests the direct effect of BDAC on FPER as well as the moderating effect of ACBSA on BDAC–FPER relationship. The paper proceeds as follows: first, it focuses on the definitions of big data analytics, the conceptual model and hypotheses development. Second, on the method, analysis and findings. Finally, we discuss the theoretical and practical contributions and provide guidelines for future research.

2. Literature review

2.1. Big data analytics capability

The concept of 'big data' is generating tremendous attention worldwide. The results of a Google search in mid-August 2014 on the phrases "big data" and "analytics" yielded 822 million and 154 million results, respectively (Agarwal and Dhar, 2014). Owing to the promise of 5–6% higher productivity and profitability, big data analytics (BDA) has received significant attention on the corporate agenda in recent years. A recent study on Fortune 1000 companies indicates that 91% of these companies are investing in BDA projects, up from 85% the year before (Kiron et al., 2014).

According to Kauffman et al. (2012, p.85), the concept of big data is skyrocketing "due to social networking, the internet, mobile telephony and all kinds of new technologies that create and capture data". Indeed, organizations are swimming in the vast sea of data which basically includes transaction data (e.g., structured data from retail transactions, customer profiles); clickstream data (e.g., web and social media content—tweets, blogs, Facebook wall postings, etc.); video data (e.g., retail and other stores); and voice data (e.g., data from phone calls, call centers and customer service).

The concept of big data is defined by Goes (2014) as massive amounts of various observational data which support different types of decisions. In their definition of big data, Schroeck et al. (2012) focus more on the greater scope of information which includes real-time information, non-traditional forms of media data, new technology-driven data, the large volume of data, the latest buzz-word, and social media data. Although 'volume' and 'variety' have received much attention in defining big data (e.g., Davenport et al., 2012; IBM, 2012; Johnson, 2012), other studies illuminate the roles of velocity, veracity (e.g., Beulke, 2011; Gentile, 2012; Russom, 2011) and the business value aspects of big data (e.g., Forrester, 2012; IDC, 2012; Oracle, 2012).

Big data analytics capability (BDAC) is broadly defined as the competence to provide business insights using data management, infrastructure (technology) and talent (personnel) capability to transform business into a competitive force (Kiron et al., 2014). The literature also focuses on strategy-led BDAC, that is, analytics that create sustainable value for business (Wixom et al., 2013). For example, Lavalle et al. (2011) identify BDAC as the ability to use big data for decision making, which is essentially connected with the firm's business strategy. Schroeck et al. (2012) focus on "competitive advantages" and "differentiation" while applying big data analytics to analyze real-time data. Kiron et al. (2014) emphasize creating an analytics climate where strategy and capability (e.g., data management, technology and talent) are well aligned in order to achieve competitive advantages. Although BDAC dimensions differ in their terminology, the taxonomy schemes proposed by the literature are similar as they reflect BDA management capability, BDA infrastructure capability and BDA talent capability-related aspects.

2.2. Theory

2.2.1. Resource based theory (RBT)

The RBT relies on two core assumptions about firm-based resources to show why some firms perform better than others and how to enhance firm performance. First, even when firms operate within the same industry, they possess a varied mixture of resources (Peteraf and Barney, 2003). This assumption of *resource heterogeneity* indicates the capability of some firms in accomplishing certain functions with the help of their unique resources. Second, these differences in resources are facilitated by the difficulty of exchanging resources across firms. This assumption indicates *resource immobility* which highlights the fact that the synergistic benefits from various resources are sustained over time (Barney and Hesterly, 2012). In addition to these two assumptions, the logic of RBT embraces the VRIO framework which clearly states that firm performance depends on the extent to which a firm possesses simultaneously valuable (V), rare (R), imperfectly imitable (I) resources which are properly organized (O) (Amit and Schoemaker, 1993; Barney et al., 2001). First, the *valuable* dimension of resources enables a firm to enhance net revenues and reduce net costs (Barney and Arikan, 2001), which in other words helps firms capitalize upon an opportunity and minimize a threat (Barney and Hesterly, 2012). Second, the *rare* dimension indicates that the resources are possessed by a small number of firms to achieve competitive advantages. Third, the *imperfectly imitable* dimension suggests that firms cannot directly copy or substitute such resources because they are costly to imitate. Research suggests that *resource complementarity* among resources within a firm