THE EFFECT OF BIG DATA ANALYTICS CAPABILITY ON FIRM PERFORMANCE

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THE EFFECT OF BIG DATA ANALYTICS CAPABILITY ON FIRM PERFORMANCE

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Abstract

*Big data analytics (BDA) has emerged as an important area of study for both academics and practitioners. Despite of rising potential value of BDA, a few studies have been conducted to investigate the effect of BDA on firm performance. In this research in progress, according to the challenges of BDA dimensions (volume, variety, velocity, veracity and value) we propose the BDA capability dimensions in line with IT capability concept. BDA infrastructure capability, BDA management capability, BDA personnel capability and relational BDA capability provide the overall BDA Capability concept. The study, by employing dynamic capability, proposes that BDA capability impacts on firm financial and market performance by mediated effect of operational performance. The finding of this research by providing essential BDA capability and its effect on firm performance can apply as a roadmap and fill the gap between managers’ expectation of BDA and what is emerged of BDA implementation.*

*Keywords: Big Data, Big Data Analytics, Analytics, Dynamic Capability, firm performance.*
1. INTRODUCTION

BDA has become a critical resource of competition and over the last several years been ranked among the top agenda items of senior executives. Firms are grappling to make sense of this rapidly increasing huge data flow that is generated from both internal and external resources by different formats. Sun et al. (2015) define big data (BD) as the data-sets from heterogeneous and autonomous resources, with diversity in dimensions, complex and dynamic relationships, by size that is beyond the capacity of conventional processes or tools to effectively capture, store, manage, analyse, and exploit.

However, BD, as a type of IS resource, in vacuum is meaningless. To uncover hidden patterns among data firms need to implement analytical process to gain value from BD and it is addressed as BDA. The implementation of BDA increases organization’s talent to capture vast amount of data, integrate them, analysis various format and structure and transform into the knowledge for decision making, which is more beyond the traditional decision making process. In this line, BDA is defined as ‘a collection of data and technology that accesses, integrates and reports all available data by filtering, correlating, and reporting insights not attainable with past data technologies’ (APICS 2012). The consecutive growth in IS/IT causes to emerge BDA as a new IT innovation to transform the way firms perform and compete. Some scholars present BDA as ‘next big thing’ in management, ‘next management revolution’ or ‘blue ocean in nurturing business opportunities’ (McAfee and Brynjolfsson 2012; Kwon et al 2014). The main role of BDA is to provide firms the recognition of what is happening now, is what likely to happen next and what should to be done to get more optimal results (Lavalle et al. 2011). BDA presents insight of mining hidden patterns to support innovation, more appropriate and real-time decisions, value creation and subsequently firm performance improvement (Manyika et al. 2011). Accordingly, both practitioners and academics continue to motivate studies on BDA high operational and strategic potentials in transforming business (Trkman et al. 2012).

While the potential benefits of BDA to enhance firm performance are significant, recent reports show that many chief information officers (CIOs) and business executives have hesitated to make major investments in BDA specifically after direct experience on disappointing results or observing other firms failing in BDA investment (Woerner et al. 2015). Manyika et al (2011) state despite the important role of BDA in value creation there is an obvious gap between managers’ expectation in applying BDA and what is currently emerged. In addition, many organizations appear to still be in earlier stage of learning how to conduct with BDA, required technologies and skills and how to create value of BDA (Barton and Court, 2012).

Therefore, underlying the mechanism that BDA influences on firm performance for value creation, should be more investigated. This mechanism provides executives the BDA competency to develop firm performance. Although an extensive research of the IT effect on firm performance exists, however, BDA characters (5Vs) make it more beyond the traditional IT/IS concept and cause new challenges in BDA usage and related effects on firm performance. The primary challenge in dealing with BDA is about rising data quantity that is driven by unstructured data. All these type of data should be integrated in the same data-warehouse and provide real-time knowledge for decision making. The high speed of data generation and quality of data resources should be added to the complexity for decision making (Lavalle et al. 2011; McAfee and Brynjolfsson. 2012). Furthermore, the real-time reacting is the other challengeable issue in line with BDA, however, common IT/IS resources are generally more statistic and predictable (Chen et al. 2015).

The question of whether firms are organized to exploit potential value of BDA to develop firm performance and manage related threats that can pose should be responded before starting BDA usage. Disproportionate growth between data captured and firm’s capabilities to process, manage, analyze, transfer BD flow to
actionable knowledge and value has remained as a challenge. In this paper, the organizational ability to conduct with BDA is considered as ‘BDA Capability’. Considering the relationship between IT investment on BDA and firm performance, we define the BDA capability as the organizational ability to utilize data assets in combination with physical IT assets and human resource to create competitive advantages. However, the assessment of the real value and effect of BDA on firm performance have still remained vague. According to the IT/IS investment and firm performance literature, we investigate the effect of BDA on firm performance that is considered by the role of BDA capability. Therefore, the study aims at examining the following research question ‘What is the effect of BDA capability on firm performance?’

We address this question by presenting BDA capability and consulting the literature on dynamic capability. We content that BDA capability provides the vase dynamic process to reconfiguration BDA resources and capabilities and enables a firm to create dynamic knowledge generation that subsequently lead to competitive advantage in highly dynamic environments. The organization of this paper is as follows: the next section focuses on BDA definition and is followed by the presentation of required dimensions for BDA capability. Section 4 presents the methodology to assess impact of BDA capability on firm performance. And the last section presents expected results of research and contribution.

2. BDA DEFINITION AND REQUIRED CAPABILITY

To define big data, the notion of ‘V’ is considered to highlight data-related dimensions. Some scholars present 3 main ‘Vs’ as ‘Volume, Velocity, Variety’ (Gartner 2012; Kwon and Sim 2012; McAfee and Brynjolfsson 2012). The ‘Volume’ is the primary BD dimension that makes BD vary from traditional concept of data. The volume of BD is currently measured in petabytes, exabytes, or zettabytes (one petabyte is equivalent to 20 million traditional filing cabinets of text). The huge volume of data is generated from large various sources by different formats, contains multidimensional data fields including structured and unstructured type and present ‘Variety’ of BD. The speed of data generation or frequency of data delivery focuses on ‘Velocity’ of BD. By considering potential economic benefits of big data, IDC (2012), Oracle (2012) present BD by 4 ‘Vs’: Volume, Velocity, Variety, and Value. Oracle defines the data that received in the original form usually has a low value relative to its volume. However, a high value can be obtained by analyzing large volumes of such data. In order to highlight the importance of data quality and reliability of BD resources, White (2012) suggests ‘Veracity’ as the fifth dimension and define BD as ‘Volume, Velocity, Variety, Value and Veracity’ which is consider as date-related dimensions in this paper as well.

According to data-related dimensions of BD, firms need efficient process to unlock BD potential value and divers BD into meaningful insights. This process is addressed as analytics approach. Analytics process can describe what has already occurred (descriptive analytics), forecast what will occurs (predictive analytics) and help determine what should happen (prescriptive analytics). The predictive and prescriptive analytics as advanced analytics that consider as the main role of BDA (Watson 2012). The BDA literature shows business leaders increasingly make decision based on data rather than intuition (Davenport 2006; Lavalle et al. 2011). Moreover, analytics approach is transforming the way of organizations run their business and competition (Kiron et al. 2012). Manyika et al (2011) count the role of BDA in value creation as creating transparency, enhancing decision-making, innovation and segmenting populations to customize actions. Das et al. (2013) add some other BDA opportunities as making time-sensitive decisions more agile than ever before and easily monitor the emerging trends within the market. Waller and Fawcett (2013) define BDA as the process of using advanced technologies to examine BD in order to uncover useful information (e.g., hidden patterns, unknown correlations, etc.) to make better decisions across business processes among functions or companies. Fosso Wamba et al define BDA ‘as a holistic approach to manage, process and analyze the “5 Vs” data-related dimensions (i.e., volume, variety, velocity, veracity and value) in order to

To conduct BDA process, firms are challenged by complex BDA dimensions (volume, variety, velocity, veracity and value) that emerge as the lack of understanding how to apply analytics approach and its importance, the lack of supportive management, lack of human resources’ skills, poor organizational culture to share data, unclear data governance, insufficient technologies to support high volume unstructured data, inadequate organizational talent to understand how can start with big data, unclear strategy to present what they should extract and why it is important, lack of alignment between the business and IT strategy and lack of strong committed sponsorship (Watson 2012; Lavalle et al. 2011). These issues contain various concepts: physical capital (BDA technologies, infrastructure and security issue), human capital resources (data scientists and organizational talent) and organizational capital resources (managerial approach, culture and business process). To respond these challenges we propose required dimensions of BDA capability by adopting from IT capability, which influences business and organizational performance.

2.1. BDA Capability Dimensions

In this paper we categorize BDA resources and BDA capability by emphasizing on Amit and Schoemaker (1993) definition. In this line, BDA resources are defined as the tradable and nonspecific firm assets and capability presented as the non-tradable, firm-specific abilities to integrate, deploy, and utilize other resources within the firm. The capability cannot be easily provided from market. The BDA resources in this study, contain various technologies, networks and applications for data capture, integrate, analysis and transforming into the knowledge beside BDA personnel who implement and utilize BDA process and finally the BDA management to govern this process. The required ability to deploy these resources are divided into the four dimensions as:

- **BDA infrastructure capability;** refers to the ability of the technology and technical software (e.g., applications, data, and networks) that make data scientists enable to quickly improve, deploy and support necessary system components (Bharadwaj 2000; McKeen and Smith 2009; Kim et al. 2012)
- **BDA management capability;** the ability of BDA executives in configuration of routines as structured manner to manage BDA resources in line with business needs and priorities (Kim et al. 2012).
- **BDA personnel capability;** the ability of data scientists (e.g., skills and knowledge about how to use analytical technologies and data analysis and make insight) to conduct with BDA (Bharadwaj, 2000; Kim et al. 2012).
- **Relational BDA capability in coordination network;** to access data resources from consumers, suppliers, competitors and business landscape, firms need to participate in an intelligence coordination network. The partnership capabilities are dynamic and present the joint ability of the partners to share data, information, technology and analytics functions to renew joint competences to track environmental changes (Shi et al. 2004; Tippins and Sohi. 2003).

The overall integrated BDA capability is the result of the interrelated relationship among these four dimensions and the synergies between them enable firms to change business processes, which in turn, lead to superior firm performance. The BDA capability presents firm’s ability to mobilize and deploy BDA resources effectively, utilize BDA resources and align BDA planning with firm strategy to gain competitive advantage and enhance firm performance. According to the dynamic capability and BDA characters firms should continuously reconfigure and renew BDA capability to provide efficient respond in line with BDA resources. We consider BDA capability as the third-order construct that capture complementarities among the four BDA capability dimensions. This overall BDA capability construct is adopted from IT capability
for the BDA dynamic characters and enhance real-time decision making. Table 1. presents the BDA capability dimensions with related attributes for each dimension.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Attributes</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 BDA Infrastructure Capability</td>
<td>Modularity</td>
<td>Kim et al. (2012)</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>Kim et al. (2012)</td>
</tr>
<tr>
<td></td>
<td>Connectivity</td>
<td>Kim et al. (2012)</td>
</tr>
<tr>
<td></td>
<td>Agility</td>
<td>Zhang (2005), Lee et al. (2007), Sambamurthy et al. (2003)</td>
</tr>
<tr>
<td></td>
<td>Security and Risk Management Service</td>
<td>Weill et al. (2002)</td>
</tr>
<tr>
<td></td>
<td>Data Management Service</td>
<td>Weill et al. (2002)</td>
</tr>
<tr>
<td>2 BDA Management Capability</td>
<td>Planning</td>
<td>Fink and Neumann (2007), Kearns and Lederer (2003)</td>
</tr>
<tr>
<td></td>
<td>Coordination</td>
<td>Weill et al. (2002)</td>
</tr>
<tr>
<td></td>
<td>BDA- Strategy Alignment with Business Strategy</td>
<td>Kim et al. (2012)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Boynton et al. (1994), DeSanctis and Jackson (1994)</td>
</tr>
<tr>
<td></td>
<td>BDA-Educated Service</td>
<td>Karimi et al. (2001)</td>
</tr>
<tr>
<td>3 Relational BDA Capability</td>
<td>Data Access and Sharing</td>
<td>Premkumar et al. (2005), Klein (2007), Zhu et al. (2013)</td>
</tr>
<tr>
<td></td>
<td>BDA Reconfiguration within Coordination Network</td>
<td>Rai and Tang (2010)</td>
</tr>
<tr>
<td></td>
<td>BDA Process Integration within Coordination Network</td>
<td>Zhu et al. (2013), Rai and Tang (2010)</td>
</tr>
<tr>
<td></td>
<td>Business Knowledge</td>
<td>Aral and Weill (2007), Kim et al. (2012)</td>
</tr>
<tr>
<td></td>
<td>Relational Knowledge</td>
<td>Bhatt and Grover (2005), Kim et al. (2012)</td>
</tr>
</tbody>
</table>

Table 1. BDA Capability Dimensions

3. THEORETICAL FOUNDATION AND RESEARCH HYPOTHESIS

Drawing on the literature on dynamic capability this study puts forward the research model in Figure 1. In this model, we contend that the complex characters of BDA (volume, variety, velocity, veracity and value) demand dynamic process to reconfigure and renew organizational resources and capabilities to obtain the potential value of BDA. Dynamic capability defines as unique organizational processes to integrate, reconfigure, gain, and release resources to respond environmental dynamism (Fornell and Larcker, 1981). This process continuously provides organizational and strategic routines by which firms can gain new competency for competition and even more create new market. We argue that unlocking potential value of BDA is the continuous and dynamic process that reconfigure resources and renew organizational ability to conduct with BDA unstable characters. In addition, providing BDA capability changes business process and the way that firms run their business. These capability consequently, influence firm performance in line
with changing operational process and financial and market performance. Indeed, BDA capability establishes knowledge creation routines particularly when market dynamism is high (Chen et al. 2015). According to the IS literature the first order effect of IS resources and capability occurs on operational process by influencing the transformational (changing a firm’s ability to collect, store, process and disseminate information) and informational process (influencing firm structure and process) (Grant, 1991). The effect on operational performance, consequently influences firm’s financial and market performance, as well (indirect effect of BDA capability) (Bharadwaj, 2000; Damanpour and Evan 1998). In this line the study hypothesis are:

H1: Firm BDA Capability have a significant positive effect on operational performance.

H2: Firm BDA Capability have a significant positive indirect effect on finance and market performance, which is mediating through a positive effect on operational performance.

Figure 1. Conceptual model BDA capability effect on firm performance

4. METHODOLOGY

To test the research hypothesis, we will employ the survey to collect data from CIO among different businesses that have invested on BDA process. We have designed survey items to ensure maximize relevance and readability for the respondents. Furthermore, the pilot-testing will be done by focusing on validity in the context of BDA capability and firm performance and the questionnaire will be modified before sending for sample group. The questionnaire contains a number of existing valid instruments that were adapted to the current study. The main goal of this survey is to investigate the relationship among BDA capability dimensions and firm performance (for each type of performance there are relative items). In particular we measure the following constructs in our research model: BDA infrastructure capability, BDA management capability, BDA personnel capability, relational BDA capability, operational performance, financial performance and market performance. To account for the differences among organizations, we also include control variables (number of employees, type of industry and size of company) for BDA capability and three dimensions of performance outcomes in the research model. To help the respondents more effectively answer the BDA capability questions, at the beginning of the survey we provide definitions of BD and BDA capability to ensure that the respondents have a common understanding of the research. A seven-point Likert scale ranging from “strongly disagree” (1) to “strongly agree” (7) will be used to measure responses and for data analyzing we will apply applied SPSS software.
5. EXPECTED RESULTS

Big data includes data-sets with sizes that are beyond the ability of traditional IT used technologies and systems to capture, analyse, manage and transform BDA into the insight. Conducting BDA demands dynamic capabilities to unlock potential value and present hidden pattern among data. This research presents the BDA capability dimensions that participate in value creation chain as the third-order construct. The BDA capability provides an overview about current firm’s ability, help them to empower in dealing with BDA and reduce the probability of failure in BDA project. Furthermore, to present the research model we applied dynamic capability to investigate how BDA capability influences on firm performance. Although there is an extant literature of BDA importance in value creation, however, the process to present this effect is vague and need more study. The main theoretical contribution of this paper is to emphasize on value creation process from dynamic BDA capability. In additions, the paper highlights that not only capturing BDA is sufficient to gain value, but also, firms need the dynamic capability to continuously reconfigure resources and firm’s ability to integrate BDA characters for decision making. This dynamic process can develop financial and market performance by mediating effect of operational performance. Collectively, the findings provide a theory-based understanding of BDA capability and usage, while also providing guidance regarding what managers should expect from implementing BDA as the rapidly emerging competitive resource. In addition, the results highlight the strategic role of BDA capability in decision making that executives should invest on it.

This research contains some potential limitations. The evolution of BDA is still in its early stage and the term of BDA capability is not distinctly mentioned in the literature. The main stress in this field is on BDA technologies and analysis process. Accordingly our research require more investigation to test the conceptual model. The other limitation to implement this study is about data collection and target sample which in this research contains CIOs and accessing to their information is critical to testing model.
References


Columbus, L. 2014a. “84% of Enterprises See Big Data Analytics Changing Their Industries’ Competitive Landscapes in the Next Year.” Forbes.

Columbus, L. (2014). Making Analytics Accountable: 56% of Executives Expect Analytics to Contribute to 10% or More Growth in 014.” Forbes.


Watson, J., (2012). "The Requirements for Being an Analytics-Based Organization". *Business Intelligence Journal*, pp. 4-6


