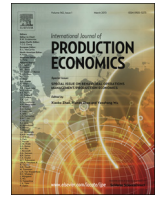




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Contents lists available at ScienceDirect

Int. J. Production Economics

journal homepage: www.elsevier.com/locate/ijpe

How 'big data' can make big impact: Findings from a systematic review and a longitudinal case study



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ARTICLE INFO

Article history:

Received 26 December 2013

Accepted 27 December 2014

Available online 5 January 2015

Keywords:

'Big data'

Analytics

Business value

Issues

Case study

Emergency services

Literature review

ABSTRACT

Big data has the potential to revolutionize the art of management. Despite the high operational and strategic impacts, there is a paucity of empirical research to assess the business value of big data. Drawing on a systematic review and case study findings, this paper presents an interpretive framework that analyzes the definitional perspectives and the applications of big data. The paper also provides a general taxonomy that helps broaden the understanding of big data and its role in capturing business value. The synthesis of the diverse concepts within the literature on big data provides deeper insights into achieving value through big data strategy and implementation.

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1. Introduction

Why should academics and practitioners be interested in understanding about the impacts of big data? The simple answer to this critical question is because big data has the potential to transform the entire business process and this paper plays a major role in conceptualizing this transformation. Due to its high operational and strategic potential, notably in generating business value, "big data" has recently become the focus of academic and corporate investigation. The extant literature identifies 'big data' as the 'next big thing in innovation' (Gobble, 2013); "the fourth paradigm of science" (p. 34) (Strawn, 2012); "the next frontier for innovation, competition, and productivity" (p. 1) (Manyika et al., 2011); the next "management revolution" (p. 3) (McAfee and Brynjolfsson, 2012); and that 'big data' is "bringing a revolution in science and technology" (p. 4) (Ann Keller et al., 2012), etc. The

rationale behind such statements is that the 'big data' is capable of changing competition by "transforming processes, altering corporate ecosystems, and facilitating innovation" (p. 2) (Brown et al., 2011); unlocking organization business value by unleashing new organizational capabilities and value (Davenport et al., 2012); and facilitating firms to tackle key of their business challenges (Gehrke, 2012).

The extant research in academia and industry shows that retailers can achieve up to 15–20% increase in ROI by putting big data into analytics (Perrey et al., 2013). McKinsey and Company found that "collecting, storing, and mining big data for insights can create significant value for the world economy, enhancing the productivity and competitiveness of companies and the public sector and creating a substantial economic surplus for consumers" (p. 1) (Manyika et al., 2011). In addition, 'big data' has the capability of transforming the decision making process by allowing enhanced visibility of firm operations and improved performance measurement mechanisms (McAfee and Brynjolfsson, 2012).

However, despite the excitement and recent interest in 'big data', little is known about what encompasses the concept. Indeed, potential adopters of 'big data' are struggling to better understand the concept and therefore capture the business value from 'big data'. Very few empirical studies have been conducted to assess

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the real potential of 'big data', with this paper acting to bridge the existing knowledge gap in the literature; drawing upon prior 'big data' studies as well as on an in-depth case study of an Australian state emergency service using 'Big data' to improve the delivery of emergency services to achieve the following research objectives:

1. Clarify the definition and concepts related to 'big data'.
2. Develop a conceptual framework for the classification of articles dealing with 'big data'.
3. Use the conceptual framework to classify and summarize all relevant articles.
4. Conduct an in-depth analysis of a longitudinal case study of an Australian state emergency service which is currently using 'big data' for improved operations delivery.
5. Develop future research directions where the deployment and use of 'big data' is likely to have huge impacts.

This article is organized as follows: after the introduction (Section 1), Section 2 provides a definition of 'big data' and discusses the potential of data-driven organizations. Section 3 introduces the research methodology, followed by Section 4 which presents our results. Section 5 is the discussion section, while Section 6 discusses the implications for research, practice, limitations and suggestions for future research. Then, Section 7 serves as the conclusion.

2. What is big data: a step toward an integrative definition

'Big Data' is generating tremendous attention worldwide. The results of a Google search on the topic rose from about 252,000 hits in November 2011 to almost 1.39 billion hits on April 4, 2012 (Flory, 2012), and then reached the impressive number of 1.69 billion hits in December 2013. This phenomenon is mainly driven by the widespread diffusion and adoption of mobile devices, social media platforms including YouTube, Facebook and Twitter, and 'Internet of Things' related concepts (e.g., RFID technology). In 2011, about 4 billion mobile-phone users were identified worldwide; about 12% of them using smartphones having the capability of turning themselves into data-streams. Meanwhile, the video platform, YouTube, received 24 h of video every 60 s (The Economist, 2011). Also, serialized products identification and tracking, for example, RFID-enabled item-level tagging, is expected to generate not only huge operational and strategic data across the value chain of all industries (Fosso Wamba, 2012; Fosso Wamba and Chatfield, 2009; Ngai et al., 2012; Ngai et al., 2009), but also an impressive volume of RFID data. Some analysts estimate that the number of RFID tags rose from 1.3 billion in 2005 to about 30 billion in 2013, thus increasing the speed in which data are generated and disseminated (deRoos, 2013).

Some scholars and practitioners have considered 'big Data' as data coming from various channels including sensors, satellites, social media feeds, photos, video and cell phone and GPS signals (Rich, 2012). However, considering the emerging nature of 'big Data', several definitions of the concept currently exist (Table 1). Some scholars and practitioners use the notion of 'V' to define 'big Data'. (Gartner, 2012; Kwon and Sim, 2013; McAfee and Brynjolfsson, 2012; Russom, 2011) define 'big Data' in terms of 3Vs: 'Volume' or the large amount of data that either consume huge storage or entail of large number of records data (Russom, 2011); 'Velocity', which is the frequency or the speed of data generation and/or frequency of data delivery (Russom, 2011); and 'Variety', to highlight the fact that data are generated from a large variety of sources and formats, and contain multidimensional data fields including structured and unstructured data (Russom, 2011). Drawing on these definitions, (IDC, 2012; Oracle, 2012; Forrester, 2012)

include another 'V', that is, 'Value' (or 4Vs) in order to stress the importance of extracting economic benefits from the available big data. (White, 2012) suggested that a fifth dimension – 'Veracity' – should be added to prior definitions of 'big data' in order to highlight the importance of quality data and the level of trust in various data sources. Some analysts estimate that 1 in 3 business leaders do not trust the information they use to make decisions (LaValle, 2009). Therefore, "if data is not of sufficient quality by the time it has been integrated with other data and information, a false correlation could result in the organization making an incorrect analysis of a business opportunity" (p. 211) (White, 2012).

There are also a set of 'big data' definitions that highlight different aspects of the concept (Table 1). For example, while (Johnson, 2012; Davenport et al., 2012) focus more on the variety aspect of data sources, other authors (e.g., Havens et al., 2012; Jacobs, 2009; Manyika et al., 2011; Rouse, 2011) emphasize the storage and analysis requirements when it comes to dealing with 'big data'. IDC (2013) identifies three main characteristics of 'big data': the data itself, the analytics of the data, and the presentation of the results of analytics that allow business value creation in terms of new products or services. Finally, Boyd and Crawford (2012) propose a more holistic definition of 'big data' that entails: technology (e.g., storage, computation power), analysis (e.g., patterns identification for economic, social, technical, and legal claims), and mythology (e.g., the widespread belief that 'big data' offers a higher level of generating valuable insights). Overall, we need to think about 'big data' not only in terms of analytics, but more in terms developing high-level skills that allow the use of new generation of IT tools and architectures to collect data from various sources, store, organize, extract, analyze, generate valuable insights and share them with key firm stakeholders for competitive advantage co-creation and realization. Therefore, we define 'big data' as a holistic approach to manage, process and analyze 5 Vs (i.e., volume, variety, velocity, veracity and value) in order to create actionable insights for sustained value delivery, measuring performance and establishing competitive advantages.

3. Research methodology

In this study, a research methodological approach that encompasses two phases was adopted. In the first phase, a comprehensive literature review of journal articles dealing with 'big data'-related topics was conducted. In the second phase, an analysis of an in-depth case study of an Australian state emergency service which is currently using 'big data' for improved emergency service delivery is realized.

3.1. A comprehensive literature review of journal articles on Big Data

In the first phase of the study, a comprehensive review of articles dealing with 'big data' related topics based on a similar approach used by Ngai and Wat (2002) in electronic commerce, (Ngai et al., 2009) in CRM and data mining and (Ngai et al., 2008; Fosso Wamba et al., 2013; Lim et al., 2013) for their review of RFID related topics. The approach entails three key characteristics: (i) the development of a classification framework; (ii) conduct the literature review and (iii) realize the classification of relevant journal articles. In addition, the study follows the recommendations of (Ngai and Wat, 2002) and focuses only on journal articles as these authors highlight that "academics and practitioners alike use journals most often for acquiring information and disseminating new findings and represent the highest level of research" (p. 416).

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