IJIRR

International Journal of Information Research and Review
Vol. 04, Issue, 02, pp.3599-3603, February, 2017

Research Article

BIG DATA ANALYTICS, COMPETITIVE ADVANTAGE AND FIRM PERFORMANCE

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ARTICLE INFO

Article History:

Received 17th November, 2016
Received in revised form
20th December, 2016
Accepted 24th January, 2017
Published online February, 28th 2017

Keywords:

Big Data,
Competitive Advantage,
Data Analytics,
Database,
Firm Performance.

ABSTRACT

Big Data refers to huge datasets that are beyond the ability of traditional database software tools, which are used to capture, store, manage and analyze data with extreme volume, velocity, and variety. It gives experts and non-experts the tools needed to analyze and understand data that was once mainly handled by data scientists and professionals. The purpose of this paper is to analyze the effects that Big Data Analytics has on the Competitive Advantage and Performance of different businesses. A critical analysis was conducted using 20 published papers from Information Systems Journals ranging from the years 2011 to 2016. The papers that were analyzed, examined Competitive Advantage and Performance of medium to large size businesses that utilize Big Data Analytics as part of their operations. Our analysis shows that Businesses using Big Data as part of their daily operations have demonstrated moderate to significant improvement in their Competitive Advantage and Performance. Findings indicate that Businesses should consider using Big Data as part of their operations, as it will improve their Competitive Advantage and Performance. Big Data enables organizations to monitor and analyze the performance of their business processes. Business process improvement can drastically influence the profit of corporations and help them remain viable.

INTRODUCTION

Technology has always had a direct impact on the world's economy and advancements. It's contributions to agriculture, manufacturing, services and knowledge assets has resulted with significant efficiency developments that shapes all environments (Chan, 2013). This evolution has now lead to the latest technological enhancement called *Big Data* requires database management systems with capabilities beyond the currently available technological capacity (He, 2014). This new discipline requires new approaches to obtain insights from highly detailed, contextualized and rich contents that may require complex math operations, such as machine learning or clustering (Chiang et al., 2012). This diversity of tools and techniques for BD analytics-driven systems makes the process non – trivial, requiring specific research on the topic. *Business Analytics* encompasses the entire function of applying technologies, algorithms, human expertise and decision making (Turban, Volonino& Wood, 2015).

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It refers to the skills, technologies, applications and practices for continuous iterative exploration and investigation of past business performance to provide actionable insights (He, 2014). This business strategy creates value by providing actionable business insights that enables businesses to detect and respond in rapidly changing environments (Chan, 2013). The advent of Big Data will have a profound impact on gaining consumer insights, improving process efficiencies and enhancing consumer experience (Vinod, 2012). To maximize the benefit of IT investments when considering different IT options, managers should focus on the technologies that can enhance their supply chain performance and improve their customer service. For example, a firm can specifically direct its IT resources to Data Analytics via Big Data to gain market intelligence to better understand and serve its customers (Quan & Mao, 2015). It is clearly time to rethink the role of IT strategy, from that of a functional-level strategy—aligned, but essentially always subordinate to business strategy—to a fusion between IT strategy and business strategy, into an overarching phenomenon we herein term digital business strategy (Bharadwaj, El Sawy, Pavlou& Venkatraman, 2013).

LITERATURE REVIEW

Big Data Analytics

Big Data comprises datasets that have become too large to handle with the traditional or given computing environment (Costello and Prohaska, 2013). It is a workflow that distils terabytes of low-value data down to, in some cases, a single bit of high-value data with the goal of seeing the big picture from the minutia (Fisher et al., 2012). Moreover, it is the term used to describe the data that can be typically hundreds of terabytes or petabytes (1015) in size and is practical for collecting data that grows very quickly (Vinod, 2012). It is also used to characterize data sets that are large, diverse and rapidly-changing, which are evident in the environments of the ever-increasing numbers of organizations (He,2014). It emerges from three trends of technology, described by Minelli, Chamber and Dhiraj (2013) as the three perfect storms: computing, data and convergence. This computing storm is a result of the expanding growth of processing power of mobile computing, social network and cloud computing. As predicted by Moore's Law, the data storm results from the accessibility of data with high volume, velocity and variety and the convergence storm is a result of the availability of open- source technology and commodity hardware (Chan, 2013).

Big Data ignited a bright future for businesses and the world in general. There are new growth opportunities for businesses and completely new types of businesses with functions which aggregate and analize large volumes of data (McGuire, Manyika, & Chui, 2012). Big Data and Analytics technology helps manufacturers extract actionable insights about their plant's operation. Plant managers can pull data from their plant's system and run it against algorithms to compare facility's current operations to the optimal range for a system or piece of equipment (Ramsey, 2014). Big data in healthcare is overwhelming, not only because of its volume, but because of the diversity of data types and the speed at which it must be managed. For big data scientist, there is, amongst this vast amount and array of data, opportunity. By discovering associations and understanding patterns and trends within the data, big data analytics has the potential to improve care, save lives and lower costs (Raghupathi&Raghupathi, 2014).

In most industries, established competitors and new entrants a like, will leverage data-driven strategies to innovate, compete, and capture value (McGuire, Manyika, & Chui, 2012). Internet of Things (IoT) is one of the cornerstones of the Future Internet. Some adopters of Big Data have a low-cost sensor imbedded in a variety of physical things or tangible products that collect real-time data (Turban, Volonino& Wood, 2015). One illustrative example of the relevance of IoT in future network development is its growing adoption within the smart city paradigm, as a tool to provide enhanced citizen services. In this sense, basic IoT technology is no longer at the purely academic research level, as it is starting to be integrated into the fabric of our daily lives (Pentikousis, Agüero, Timm-Giel &Sargento, 2014). These sensors can regulate temperature and climate, detect air particles for contamination, monitor machinery conditions for failures and detect engine wear or maintenance (Turban, Volonino& Wood, 2015). The use of these sensors in a wide variety of products, such as children's toys and industrial goods, assists in obtaining feedback of customer use. This knowledge is then used to create new products, designs and services (McGuire, Manyika, & Chui, 2012). Google is reinventing people management using advanced analytics. Others have discerned that firms which use analytics and big data can segment markets specific to the needs of the individual customer, a capability that creates opportunities for new kinds of businesses (Bell,2013). Another benefit of Big data is its characteristic of prediction, through 'nowcasting,' the ability to estimate consumer confidence in real time (McGuire, Manyika, & Chui, 2012). Big Data paradigm is taking hold of the strategies for future development of all global industrial players, and it is not unrealistic to assume that it will become commonplace in the short-term (Pentikousis, Agüero, Timm-Giel &Sargento, 2014).

Competitive Advantage

Nath, Nachiappan and Ramanathan (2010) proposed that the linkage between a firm's functional capabilities and financial performance depends on the firm's relative efficiency to integrate its resources into capability and the ability to use optimally, its function-specific resources to achieve function-specific objectives. In other words, the resource-to-capability conversion depends on competencies to optimally integrate and use resources for capability building. The literature suggests, that this perspective links the competitive advantage of organizations to resources and capabilities. A business's competitive advantage is built on a set of strategically relevant resources. The resource-based perspective takes the business's internal approach. The logic is that the business's unique capabilities in terms of knowledge and managerial ability are important resources which may create sustained competitive advantages (Omerzel, Gulev, 2011).

Knowledge Management is defined as the competitive capabilities that an organization uses to create value in its processes, products, or services. The benefits of Knowledge Management are mostly studied for large organizations, but they can also be achieved in medium sized firms (Supyuenyong, Swierczek, 2013). Part of the Knowledge Management concept questions is, how is this knowledge which comes from information processed? Information processing is the foundation for the acquisition and use of knowledge for business's. The effectiveness of a business is at peak, when the information-processing capacities of the structure fits the information-processing requirements of the output (Griffith, Sawyer, 2010). As expressed by Fransson, Håkanson, &Liesch (2011), sustainable competitive advantage can come from the control of resources that are valuable, rare and non-substantial.

Big data requires database management systems with capabilities beyond those in standard SQL-based systems. According to Manyika et al. (2011), the projected demand for deep business analytical positions could exceed the supply produced by the current trend of 140,000 to 190,000 positions, in addition to the projected need of 1.5 million managers and analysts for handling big data business analytics in the United States (He, 2014). As we know from the knowledge and intelligence approaches, information and data do not reveal their full value until insights are drawn from them. Hence, big data becomes useful when it enhances decision making (Erickson & Rothberg, 2014).

Table 1. Reviewed Articles

Year	Article	Findings / Contribution
2011	Creating Business Value with Analytics	Organizations with a data-oriented culture recognize analytics as a strategic asset, have strong leadership support for analytics and make insights from data widely available within the organization.
2011	Big Data, Analytics and the Path from Insights to Value	Analytics driven opportunities are central to growth and success.
2011	Knowledge resources and competitive advantage	Strategic resources and capabilities that help determine the extent of competitive advantage is knowledge (data).
2012	Leveraging BIG DATA for competitive advantage in travel	Big Data can create competitive advantage by providing insights into consumer behavior patterns and improving process efficiencies for profitability that was previously not possible.
2012	Four strategies to capture and create value from Big Data	Companies that effectively create and implement Big Data strategies stand to gain a competitive advantage.
2012	Why Big Data Is the New Competitive Advantage	Improved performance, better risk management, and the ability to unearth insights that would otherwise remain hidden.
2013	Big data: Friend or foe of digital advertising?	Digital Big Data generated by the Internet now are providing consumers with pricing transparency across many product categories, allowing them to easily and quickly find the lowest price for any product.
2013	Content analysis in an era of big data: A hybrid approach to computational and manual methods.	Computational methods using Big Data combined with manual methods help provide advantage.
2014	Big Data solutions on a small scale: Evaluating accessible high-performance computing for social research	Big Data solutions can also enable robust, deep, and fruitful research outcomes.
2014	Big data and competitive advantage at Nielsen	Big Data helped regain competitive advantage that had eroded.
2014	Using 'Big Data' to deliver a competitive advantage	Leveraging Big Data helps managers understand how to operate their business.
2014	Using big data to improve customer experience and business performance.	Big Data can create sustainable competitive advantage for customer service.
2014	Big data analytics in healthcare: promise and potential	Big Data Analytics has the potential to transform the way healthcare providers use sophisticated technologies to gain insight from their clinical and other data repositories and make informed decisions.
2014	Business Intelligence and Big Data Analytics: An Overview	Schools are filling the knowledge gap by providing programs about data analytics.
2014	Big data and the government agency	Managers must be aware that Big Data holds major benefits for their customers.
2014	Study on the Implementation of Budget Performance Evaluation from the Perspective of Big Data	Big data thinking and techniques helped improve budget performance.
2015	Leveraging Big-Data for Business Process Analytics	Big Data solutions produced remarkable results in two real functional environments.
2015	Big data, bigger dilemmas: A critical review	There is a competitive advantage for institutions and corporations that can afford the computing infrastructure necessary to analyze Big Data.
2016	Social media and the social sciences: How researchers employ Big Data analytics	There is a big need for critical data analysis using Big Data.
2016	Big Social Data Analytics in Journalism and Mass Communication Comparing Dictionary-Based Text Analysis and Unsupervised Topic Modeling	Big Data produced valuable information in both analysis methods.

Decision-making is enhanced, only when analytical techniques are applied and some element of human interaction is applied (Zhao, 2013). Big data has the potential to add value by providing transparency with immediate performance feedback, experimentation with quick results, more precise segmentation, more objective decision-making (algorithms rather than humans) and new products (Manyika, et. al., 2011).

Business Performance

A firm can direct its IT resources to the business analytics of big data to gain market intelligence, to detect opportunities to introduce new products, to attract new customers and to retain existing customers (Quan & Mao, 2015). Organizational factors are important predictors of whether an organization will be able to create a competitive advantage with analytics. In effect, the most advanced users of analytics typically have a strong data-oriented culture that supports and guides analytics use. Having the right combination of tools, data and people, while necessary, is usually not enough.

Without strong cultural commitments, the success of an analytics program can be easily shortchanged or derailed (Kiron & Shockley, 2011). Big Data and predictive analytics (BDPA) can be extensively used for improving supply chain performance by improving visibility, which is identified as one of the most important organizational capabilities to improve organizational performance (Barratt and Oke, 2007), resilience and robustness (Brandon-Jones et al. 2014). Columbus (2015) characterizes BDPA as a capability that generates cost savings for Supply Chain Management processes and contributes to the competitiveness of a firm. Other scholars underline the importance of BDPA for improving organizational performance (Schoenherr and Speier-Pero, 2015), leveraging decision-making (Bose, 2006) and transforming the supply chain (Jeyraj et al., 2006; Waller and Fawcett, 2013). McGuire et al. (2012) further argue that innovative firms seek to beat competition by finding new ways to leverage BDPA for next-generation products and services, increasing information transparency and decision-making effectiveness via data digitization and accessibility; and precisely segmenting their

customer base as 'who', 'what', 'when', and 'where' for various products and services. Therefore, BDPA assists in achieving higher levels of performance (Waller and Fawcett, 2013). Organizations that have moved beyond baseline analytics — transformed and experienced users — are disproportionately using analytics to focus on the future, on the customer and on increasing efficiencies at greater depth and scope than aspirational users. Transformed companies tend to have a data oriented culture as well as competency in two areas: information management and analytic expertise. Both competencies require capabilities and resources beyond what is typically invested in baseline analytics (Kiron & Shockley, 2011).

METHODOLOGY

A critical analysis was conducted using 20 published papers from Information Systems Journals ranging from the years 2011 to 2016. The papers analyzed, examined Competitive Advantage and Performance of medium to large size businesses that use Big Data Analytics as part of their operations.

DATA ANALYSIS

The critical analysis of the reviewed articles is illustrated in Table 1. These articles were reviewed and their main contributions were collatedin this article. All the papers reviewed provided positive linkages between Big Data and its impact on competitive advantage and firm performance.

DISCUSSION AND CONCLUSION

This analysis conveys that Businesses using Big Data as part of their daily operations have demonstrated moderate to significant improvements in their Competitive Advantage and Performance. Findings elucidate that Businesses should consider using Big Data as part of their operations because it can improve their Competitive Advantage and Performance. Big Data enables businesses to monitor and analyze the performance of their business processes. Process improvement can drastically impact the profit of corporations and assist in remaining viable. However, the use of traditional Business Intelligence Systems is not sufficient in meeting today's business needs. They normally are business domain-specific and have not been sufficiently process-aware to support the needs of process improvement-type activities. This is so, especially in large and complex supply chains, where it entails integrating, monitoring and analyzing a vast amount of dispersed event logs, with no structure, and is produced on a variety of heterogeneous environments.

Big Data is a versatile asset, that is extremely imperative to the advancement and benefits of improving care, saving lives and lowering costs. It also has a profound impact on gaining consumer insights, improving process efficiencies and enhancing consumer experience. This study contributes to the literature by analyzing the benefits of this technology through Competitive Advantage and Performance. While this tech is relatively new and still rising, some may argue that a standard Database Management System will suffice, nevertheless, researchreflects the numerous ways in which Big Data can improve the operations of businesses across disparate sectors

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