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# Managing big data in the retail industry of Singapore: Examining the impact on customer satisfaction and organizational performance

Song Ying <sup>a, b, \*</sup>, Stavros Sindakis <sup>c, d</sup>, Sakshi Aggarwal <sup>e</sup>, Charles Chen <sup>f</sup>, Jiafu Su <sup>d</sup>

<sup>a</sup> Research Center for Economy of Upper Reaches of the Yangtze River, Chongqing Technology and Business University, Chongqing, 400067, China

<sup>b</sup> College of Business and Administration, Dongbei University of Finance and Economics, Dalian, China

<sup>c</sup> Department of Management, College of Business Administration, University of Sharjah, Sharjah University City, P.O. Box 27272, Sharjah, United Arab Emirates

<sup>d</sup> National Research Base of Intelligent Manufacturing Service, Chongqing Technology and Business University, Chongqing, 400067, China

<sup>e</sup> Institute of Strategy, Entrepreneurship and Education for Growth, Cyprus

<sup>f</sup> School of Business, University of Phoenix, USA

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## ABSTRACT

Much of the research on big data analytics has been centered on technical or system development. Research has been carried out on the usage of big data analytics to understand customer relationships and experience, amongst others. Still, there is a lack of research in the retail industry considering big data management, examining the impact on customer satisfaction and organizational performance in the retail sector. Retailers explore analytics to gain a unified picture of their customers and operations across the store or online channels and make strategic decisions contributing to the growth of the retail industry. Thereof, this study has been conducted by majorly focusing on the Singapore retail industry to clarify the feasibility of big data management analytics. Quantitative research method was employed involving 500 participants from the retail industry of Singapore. The results of the study stated that amongst the different big data analytics utilized within the retail industry of Singapore, social media analytics had been majorly answered by the participants. Future researchers can study about the upcoming retail trends in Singapore and how the effects of big data analysis changed in the past few years and deal with the unexpected future recessions in the retail industry within Singapore.

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## 1. Introduction

Several organizations suffer to maintain large sets of data and the related nontraditional data structures. Different factors of expanding data management skills of an organization and enhancing the portfolios in terms of data management software are also implemented for big data management. Such measures help in increasingly automating the operations of the organization, and the outcome of such processes is the big data management (BDM). The big data should be permanently placed within the data management system of organizations (Russom, 2011). The ability to access,

analyze, and manage enormous data volumes besides the fast evolution of information architecture is increasingly critical for retailers who intend to improve business and performance efficiency. Although the key to success is suitable customer experience, operational efficiency, loyalty, and customer retention, the demand of anticipation is significant for the proficient management of inventory, cash, and overall profitability. While retailers grow and extend in the diverse market, the data type that is commonly managed has become more complex. However, the analysis of such complex data leads to a comprehensive understanding of the product's path to profitability (Ernst and Young, 2014).

Retailers have collected customer data that was later tied to the loyalty cards (Oracle, 2016), which mainly depict what was previously purchased by customers. These data highlight the buying patterns of customers, although not indicative of the demands of the future. However, with the inclusion of big data, retailers intend to understand customer requirements of the future concerning customers' families and network buying patterns to gain a better

\* Corresponding author. Research Center for Economy of Upper Reaches of the Yangtze River, Chongqing Technology and Business University, Chongqing, 400067, China.

E-mail addresses: [songying@ctbu.edu.cn](mailto:songying@ctbu.edu.cn) (S. Ying), [ssindakis@sharjah.ac.ae](mailto:ssindakis@sharjah.ac.ae), [ssindakis@ctbu.edu.cn](mailto:ssindakis@ctbu.edu.cn) (S. Sindakis), [s.aggawal@iseeg.org](mailto:s.aggawal@iseeg.org) (S. Aggarwal), [kalebiz@email.phoenix.edu](mailto:kalebiz@email.phoenix.edu) (C. Chen), [jeff.su@cqu.edu.cn](mailto:jeff.su@cqu.edu.cn) (J. Su).

view. Retailers are thus aspiring to go beyond the mere capture of customer preferences received from data and retain competitive advantage by extracting notable value from big data analytics (Brown, Massey, & Ward, 2016; Wang, Gunasekaran, Ngai, & Papadopoulos, 2016). Data and inputs to the supply chain, such as checking on-shelf availability and product visibility, are now enabled by active customer participation and through emerging technologies. Taking a customer perspective in a service supply chain (Maull, Galdi, & Johnston, 2012; Rai & Bajwa, 1997), retail checkout processes should begin with customers when they are ready to checkout (Aloysius, Hoehle, Goodarzi, & Venkatesh, 2018).

Moreover, retailers face a fragmenting audience as new channels emerge and fight for the attention of consumers. "Big Data" is the industry's loudest buzzword (Waller & Fawcett, 2013) and is looked upon as a solution to many of the new age retail challenges, but there is virtually no uniformity in defining Big Data, identifying its purpose, or establishing its role in retail management. In general, categorizing, assessing quality, and identifying Big Data's impact are very new to management (Chauhan, Mahajan, & Lohare, 2017; George, Haas, & Pentland, 2014), and not much research has been conducted on this topic.

With the increasing number of network devices of the prominent Data's involvement in the companies, this leads to higher consumption rates by different business analysts for in-depth novel information. Therefore, this study intends to understand the role of the management of big data within the retail industry, especially focusing on Singaporean retail industry to study the strategies, approaches, and methodologies; to understand the tools, technologies, strategies, methods, and problems; to explore the awareness of the competencies that can arise from data analytics tools for managing big data in retail practices. Thus, it has been observed that many retailers are focusing on using data management for the predictive analysis to understand the future demand of customers. This new approach will help them understand customer demands in advance and allow them to have a possible proactive strategic solution to their requirements (Oracle, 2016). Based on this aspect, the following research questions have been developed for the present study:

RQ1: What are the main strategies, approaches, and methodologies that are used for managing big data process in the Singaporean retail industry?

RQ2: What are the tools and technologies used in reducing barriers for managing big data in the Singaporean retail sector?

RQ3: What possible competencies can arise from data analytics tools for managing big data in retail practices, especially in relation to the retail environment in Singapore?

RQ4: How does the use of Big Data affect organizational performance and customer satisfaction in the retail industry of Singapore?

The present study focuses on understanding the impact of data management on different retailer companies by dividing the investigation into different sections. The introduction of the study, which highlights the background, is followed by the reason for conducting the study, and research questions. The second section, i.e., the literature review focuses on highlighting past studies and related information on the content that could allow understanding the history of the topic. The third section is the methodology, which describes the processes that were followed to complete the study. The fourth section explains the outcomes of the study and the reason for obtaining it. The last section concludes the research and highlights the recommendation for future researchers.

## 2. Literature review

As mentioned in the introduction, most retail business ventures

need to generate information regarding future buying trends of customers through big data sets (Buluswar, 2016). Contrarily, big data sets bring a challenging situation for retail enterprises in terms of their management accordingly and professionally, which needs to focus on specific strategies to solve the issue and create competencies for businesses (Davenport, 2014; Davenport, Barth, & Bean, 2012). Thereof, retailers must understand the essential levers beyond information technology that would enable them to derive maximum benefit from customer data. They need to understand the best possible ways to collect, store, analyze, and deploy knowledge from and/or of customers so that such knowledge can provide them with a sustainable competitive advantage (Chauhan et al., 2017; Mukherji, 2012). Fundamentally, this part analyzes the previous studies (e.g., Belarbi, Tajmouati, Bennis, & Tirari, 2016; Chauhan et al., 2017; Ernst and Young, 2014; Kaisler, Armour, Espinosa, & Money, 2013; Lee, 2017; Paradigma, 2015; Smith, 2014) conducted to evaluate the impact of BDM on organizational performance and customers' satisfaction, which are the key factors for business growth in the retailing industry.

### 2.1. Big data

The term Big Data refers to the information, which cannot be processed with the help of traditional tools. In other words, a large volume of datasets involves complex information called the big data, which is not handled manually (traditional method of arranging or organizing big data) (Zikopoulos & Eaton, 2011). However, Davenport et al. (2012) qualitatively analyzed that key factors that differentiate big data from small data are the volume of datasets and availability of various texts, images, videos, and sounds. In big datasets, different kinds of data can be included, such as structured and unstructured data, semistructured data, multi-structured, and streaming data that comprise of various factors, including text language, information extracted from different machines or applications on the web, and social media (Davenport et al., 2012).

Although big data is considered essential for businesses to be aware of their surroundings with efficacy; however, BDM is a critical factor for most organizations. Managing Big Data is also known as a process that involves two concepts called big data and its management to achieve organizational objectives (Loshin, 2010). This perspective has been further explained by other researchers (Xiaofeng & Xiang, 2013), by stating that the process of managing big data (to store it and analyze through following ethical privacy rules) is called Big Data Management. In accordance with this qualitative study (Xiaofeng & Xiang, 2013), BDM is also a broad concept that consists of several steps, such as the warehousing of data, data integration, quality analysis, data governance, the arrangement of data content, the administration of database, and processing.

However, several organizations that adopted big data are facing different challenges, such as complexities in handling the sets and trained workers to use it. Equally, the identified research does not answer what kinds of industries (having big data) are involved in big data management. In this context, previous studies (e.g., Adrian, Abdullah, Atan, & Jusoh, 2017; Berman & Evans, 2013; Chauhan et al., 2017; Howe, 2014; Lekhwar, Yadav, & Singh, 2019; Russom, 2011; Sagioglu & Sinanc, 2013; Wamba et al., 2017) do not entirely explain the need for BDM in the retail industry, which raises a question as to what extent this industry should be involved in this process, which has been answered in the present research.

### 2.2. Big data management in the context of retail industry

The trend and rapid growth of data require organizations to

improve organizational resources and create new, more effective data-driven business models. The use of big data provides new insights for valuable information and boosts the organization's competitive advantages (Adrian et al., 2017; Lekhwar et al., 2019; Wamba et al., 2017). Correspondingly, McKinsey Global Institute specified the potential of big data in five main topics, which is discussed by Sagioglu and Sinanc (2013, May), i.e., Healthcare: clinical decision support systems; Public sector: creating transparency by accessible related data, improve performance, and discover needs; Retail: in-store behavior analysis, product placement design, variety, and price optimization, improve performance, labor inputs optimization, distribution and logistics optimization, and web-based markets; Manufacturing: improved sales support, demand forecasting, supply chain planning, developed and web search-based applications; and Personal location data: smart routing, urban planning, and new business models.

In detail, BDM is defined by Santoro, Fiano, Bertoldi, & Ciampi (2019) 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) and is emerging as a strategic aspect for firms (Alfouzan, 2015; Brynjolfsson & McAfee, 2012, pp. 1–8). BDM and analytics allow managers "to measure and know radically more about their business and to translate that knowledge into decision making and performance directly" (Brynjolfsson & McAfee, 2012, p. 4). Managers may make decisions based on big data analytics, which can shape decision-making and business processes (Santoro et al., 2019). More specifically, the concept of big data has been used to describe data sets that are so complex that they cannot be managed or analyzed using traditional data analysis software, making it necessary for firms to outsource big data infrastructure and hire skilled employees (Santoro & Usai, 2018).

On the other hand, Lee (2017) suggested the three dimensions of big data, i.e., the 3 Vs.: *volume* (the amount of data an organization or an individual collects and generates), *variety* (the number of data types), and *velocity* (the speed at which data are generated and processed) used as a common framework to describe big data (Belarbi et al., 2016; Chen, Chiang, & Storey, 2012; Gandomi & Haider, 2015; Kwon, Lee, & Shin, 2014; Lee, 2017) proposed in the computing industry. Therefore (Chen & Zhang, 2014; Mneney & Van Belle, 2016, January), added the fourth and fifth V's: *Veracity* in big data that refers to the unreliability inherent in some source of the data and ensures that the data used is trusted, authentic, and protected from unauthorized modification. Moreover, fifth V: *Value* in Big Data, the compelling advantage an organization gets from the insights it gets using Big Data. Big Data has a relatively low-value density meaning that low value is yielded relative to the volume of data received. Still, the higher value can be obtained by analyzing larger volumes of data. Big Data requires technical infrastructure, processing tools, and techniques to cope with the volume, velocity, variety, and generate value out of the data collected. The tools and techniques required to implement Big Data can be grouped into two; data management and data analytics (Loshin, 2010). This perspective has been further explained by other researchers (Belarbi et al., 2016; Bendre & Thool, 2016; Xiaofeng & Xiang, 2013) by stating that the process of managing big data (to store it and analyze by following ethical privacy rules) is called Big Data Management.

Retail Industry deals with retailing business activities in which selling of goods and services to consumers is done by following the business-to-consumer (B2C) model (Berman & Evans, 2013). Retailers need useful data, but more importantly, they need the right data to gain insights that can transform their businesses. Value comes from analyzing new data types in the context of specific business knowledge, such as transaction log (T-log) and loyalty

information, campaign results, and pricing actions (Howe, 2014). The retail sector all over the world currently consists of a number of organizations involved in the process of retailing in which supermarkets and other food and clothing outlets are included. Today, the annual worldwide revenue for retail industries is relatively high because the largest 250 retailers (situated in the UK, the US, Singapore, and other regions of the world) are being profited (Berman & Evans, 2013). By contrast, a constant change in trends and the process of globalization is proving to be a challenging situation for retail industries to deal with customers' demands and manage the internal environment accordingly through obtaining essential information about customers (Kumar & Reinartz, 2012). To deal with unexpected future recessions, most retail organizations are gathering vast information about customers that may contribute in offering innovative products and services to the increasing sales. On the other hand, this cannot be a prolific decision until the big datasets are not managed. Therefore, organizations categorized as retail firms have adopted BDM methods involving advanced technology.

Mainly, professionals have identified that multistructured data and other types of big data are focused on being managed in the retail industry (Chaudhuri, 2012). According to Belarbi et al. (2016), the value of big data analytics in the retail industry can be obtained from analyzing big data to help decision-makers: first, customer targeting beneficial for noting an individual's behavior to examine customer satisfaction. Secondly, inventory management that can improve stock forecasting and predict changes in demands. Thirdly, price optimization used to analyze market demands on price or products changing, which can then be derived to get an optimal pricing decision — lastly, in-store behavior and customer sentiment analysis. Retailers can collect information on customer's in-store behavior such as time spent in different parts of the store, and the data collected can be analyzed to improve store layout, shelf positioning, and product mix (Aktas & Meng, 2017; Belarbi et al., 2016; Sagioglu & Sinanc, 2013). Moreover, it has been evident that in the retail industry, the mainstream methods of BDM have been crossed. At this level, one most important question that has been less answered by the researchers yet is that what kinds of critical strategies or techniques are employed by the retail organizations to manage big data.

### 2.3. Strategies (technology-oriented), approaches, and methods for managing big data in the retail industry

Commendably, there have been several strategies adopted for managing big data in any sector. However, many researchers and analysts proclaim that big data can be managed through a wide range of strategies or approaches to technology, particularly in the retail industry (Intel, 2014; Soares, 2015). Retail organizations have often used certain specific strategies or technology-oriented methods for big data management. According to the study of Davenport et al. (2012), most of the retail organizations integrating big data are employing or following Very Large Data Bases (VLDB) paradigm for big data management. It is a time-effective process to handle massive information through computerized systems of software rather than working manually.

On the other hand, traditional methods and manual processing may create a hurdle for responsible authorities to deal with large datasets, as big data are measured in tens of terabytes, millions of terabytes, and in petabytes. Nevertheless, Davenport et al. (2012) claimed that VLDB is only adequate for those retail firms dealing with structured data exclusively. At this stage, Madden (2012) posited that other multiple types of data management tools, platforms, or technological approaches could be utilized, which is based on software solutions to accommodate big data and its

diversity.

Most of the retail firms within the sector follow “Fork in the road strategy,” which deals with the management of big datasets along with existing platforms or specific-designed solutions (Intel, 2014). However, this strategy is often considered a time-consuming approach; therefore, some of the organizations are involved in standard processes, instead of depending on a specific strategy (Chen et al., 2012). By contrast, Russom (2011) investigated the relevant subject and projected that few retail enterprises believe that Big Data strategy is a competent business approach to increase profitability. This must be reliant on sufficient strategies or technologies, as found in the Master Data Management System, such as BDM analytics, enforced governance, ebay.com (that uses two data warehouses for big data management, one at 7.5 petabytes and second at 40 petabytes; K-Square, 2010). This concept was also given by Loshin (2010) by projecting that appropriate data governance or analytics is a feasible technique, which plays a central role in managing big data similar to the integration options, in which movement of the physical location of the data is not required to manage big data. Conversely, this raises the question that whether the lack of maturity and knowledge in integration options may make these strategies of managing big data ineffective in the retail industry where the loss leads the business toward shutting down. Therefore, the current study aimed to evaluate the impact of BDM strategies used in the retail industry on organizational performance and customer satisfaction. Thus, the research question is: “What are the main strategies, approaches, and methodologies that are used for managing big data possess in the Singapore retail industry?” Relying on different studies and researchers’ views, it has been found that BDM has widespread impacts (both positive and negative) on the organizations, but these have not been explicitly mentioned in the context of performance and customers’ buying trends in the retail industry. Similarly, researchers remained unsuccessful in defining as to how the adverse effects of big data can be lessened if rational or irrational decisions are made, which leaves ambiguity for its importance and requires investigations to solve key barriers influencing big data management.

### 2.3.1. Key barriers influencing big data management and solutions

In the previous sections, it has been observed that the advantages of BDM are countless, particularly for customers and businesses (retail firms). Conversely, researchers (Chen & Zhang, 2014; Gandomi & Haider, 2015; Ohlhorst, 2012; Russom, 2011) believe that all the benefits of big data and its management are only enjoyable if there is no barrier hindering the process of data management, and its utilization for successful business operations. In a related study (2011), it was observed that various barriers influence the BDM process and create detrimental impacts. However, the major stumbling obstacle for all retail organizations within the industry in using Big Data and managing it could be customers consenting access to personal information (Smith, 2014). Although, customers permitting access to the personal information often hinders the data collection process and causes ineffective information to offer the innovative and demanded products and services, but the maintained quality of specific big data is also the biggest threat to the retail businesses’ success (Kaisler et al., 2013). This is because higher volumes of data increase the complexity of arranging information, and thus, individuals are involved in focusing on their feasibility by reducing some relevant information. Another barrier that may become a problem in managing big data is associated with the appropriate characterization of the collected data. In most cases, there is a possibility that the information gathered from individuals is not easy to incorporate specific categories or themes. Thus, it becomes difficult to manage it with efficacy. This problem is also related to the data visualization of a

responsible person (Chen & Zhang, 2014).

Furthermore, Chen and Zhang (2014) presented some other problematic barriers that could create detrimental effects on the retail industry, such as inappropriate staffing and skills, incongruous infrastructure, tools, and technology of managing big data, and irrational decisions of associated managers (immaturity of responsible authorities to handle new types of data along with human and capital resources). These factors are the prime barriers for retail firms often faced by them while processing Big Data. Besides, Sagiroglu and Sinanc (2013) projected that designs of big data management, loading of large data sets, big data scalability, bandwidth network, and query processing speed have also been proved as challenging barriers for the retail industry. However, previous publications do not determine that these challenges also affect retail sectors, which favor the completion of extensive research on the relevant subject. Hence, as per the second research question: “What are the tools and technologies used for reducing barriers for managing big data in the Singapore retail industry?” the subsection below explains the tools and technologies that would help in reducing barriers for managing big data in the Singapore retail industry.

### 2.3.2. Big data tools and technologies

To capture the value of big data, we need to create new techniques and technologies for analyzing it. Until today, scientists have developed a wide variety of techniques and technologies to analyze, capture, curate, and visualize big data. Even so, they are far away from meeting a variety of needs. These techniques and technologies across several disciplines, including computer science, economics, mathematics, statistics, and other expertise (Chen & Zhang, 2014). Likewise, Belarbi et al. (2016) gave a short overview of some of the main techniques of big data analytics that are drawn from mathematical and statistical disciplines.

- i. Data mining refers to techniques that are used to extract patterns from data, such as rule learning, cluster analysis, classification, and regression, which can be used to determine, for example, the characteristics of successful employees or even determine customer purchase behavior.
- ii. Optimization methods are the numerical techniques used to redesign a system or process. Optimization methods can be applied to improve performance according to a specific measure.
- iii. Neural networks: refers to computational models based on biological neural networks and used for detecting patterns in data that can be used for pattern recognition, image analysis, optimization, and adaptive control.
- iv. Machine Learning: is an artificial intelligence technique that allows computers to adapt to behavior based on empirical data to make intelligent decisions based on information.
- v. Predictive modeling: uses a set of models to predict the probability of an event occurring, which can be applied, for example, to predict the potential that a customer can be cross-sold another product.
- vi. Cluster analysis: uses techniques that allow turning a diverse group into a smaller group with similar characteristics; it can be used for segmenting consumers into groups to perform better marketing.

### 2.4. Possible Competencies for Retail Industry in Practicing Big Data Management

Commonly, it is analyzed that if the retail industry is involved in BDM efficiently, then precise competencies and opportunities can arise from data analytics tools after significant practices. For

instance, BDM is expected to increase understanding regarding customers' behavior and preferences according to which the performance level of firms can be improved (Paradigma, 2015). This is because, in turn, BDM practicing provides accurate indicators of noticing and analyzing customer behavior. Additionally, BDM powerfully enables retailers to achieve organizational goals, including the new level of sophisticated marketing and successful operations management for high revenues (Davenport, 2014). This happens because of the different tactics or capabilities obtained after practicing big data management. The leading fundamental tactic or opportunity obtained by the retail industry through BDM is the crunch of amounts of customer behavior data toward buying products (Franks, 2012). Because retailers are able to adjust and redesign the marketing strategies proactively. On the contrary, it is undefined in the identified publication that to what extent this opportunity helps raise sales. Therefore, the research gap or the question that is essential to resolve is: What possible competencies can arise from data analytics tools for managing big data in retail practices, especially in relation to the retail environment in Singapore?

Commendably, mass customization or customization are also significant opportunities for retailers, and it comes from BDM practices (Russom, 2011). In other words, BDM provides retailers with a platform for a unique opportunity of operating and behaving like neighborhood shopkeepers, where they are aware of other patrons personally. Recent research published in the Harvard Business Review (2017) shows that this opportunity is necessary because of boosting sales by more than 10% for the retail industry. Another possibility for the retail industry after practicing BDM is to identify the most valuable customers through the customer pyramid tremendously, to contribute to high profits, i.e., lead, silver, gold, and platinum (Gandomi & Haider, 2015). At this level, it is essential to know that BDM does not only provide this capability by motivating new customers, but also retains the old or existing consumers who are expected to increase their sales, as found in the case of Aberdeen Group (a retail organization), which enabled to engage customers and compete in markets. In related explanatory research (McAfee & Brynjolfsson, 2012), it was investigated that one of the greatest opportunity or benefits for the retail industry is to leverage the technology revolution, which has become inexpensive for this business sector by examining centralized databases to ensure high quality of big data management. Briefly, most studies suggest that BDM application is obligatory for businesses, particularly retail firms, to experience growth given the Competencies for Retail Industry in Practicing Big Data Management. Thus, the major influence of practicing big data and growth is on organizational performance and customers, which is highlighted in the below section.

### 2.5. Big data impact on organizational performance and customer satisfaction

Generally, it has been observed that once big data is managed with efficacy through the adoption of appropriate strategies, then companies are enabled to enjoy different benefits. It is evident from the Ernst and Young report (2014) published by conducting different surveys and employing a quantitative approach. This report explored the fact that big data with proper management allows firms to make rational decisions whether the production or distribution of products and services should be increased or not following customers' demand. This is because customers are highly satisfied with the organizations' services when they are informed about company-devised strategies, which is only possible through big data, a useful set of information for both consumers and suppliers (retailers) (Ernst and Young, 2014).

Conversely, Ernst and Young's report (2014) was not providing theoretical and conceptual evidence in this context. Consequently, this situates the research gap and the question, "How does the use of Big Data affect organizational performance and customer satisfaction in the retail industry of Singapore?" This question was later answered in another study published by Paradigma (2015). This investigation was primarily done in the NH Hotel. In this research, Paradigma (2015) revealed that big data is directly correlated with customer satisfaction, as it allowed the identified hotel management to increase the level of customer satisfaction by gaining their trust through offering standard quality and time-effective services.

Similarly, another study (Jewell et al., 2014) showed big data assists customers to not only engage in organizational activities and offers, but also makes them aware of the legal or illegal activities such as fraud or corruption with efficient monitoring, which lessens the chances of firms' involvement in such a movement to retain their customers. Unfortunately, these investigative publications do not explain the impact of BDM on customers belonging to the retail industry and the specific sector's performance (Intel, 2014). On the other hand, Davenport et al. (2012) stated earlier that every organizational or industrial performance is also positively influenced by big data management, because it gives the capacity to optimize and alter organizations' functions and processes after knowing the consumers' buying attitudes. With the help of a BDM approach, most retail firms are able to integrate internal as well as external information and enhance their controls (particularly on the human resource) to fulfill demands of stakeholders. This aspect eventually favors creating a competitive market advantage by managing risks (Davenport et al., 2012).

To accomplish research to assess the impact of BDM on both customer satisfaction and organizational performance, a mixed-method approach was selected by Smith (2014) to evaluate the concept of big data as one of the most significant recent buzzwords in terms of business and technology. Therein, various IT retail companies, such as Hewlett-Packard, International Business Machines, and Oracle, were selected, as they have integrated big data analytics programs for creating unique packages for customers and the information was gathered through interviews (Smith, 2014). The primary results supported by the extensive secondary research explored that big data affects the buying trends of customers in the retail industry (in both positive and negative ways). Smith (2014) claimed in his research that big data is mutually beneficial to both the retail companies' performance (fewer employees' turnover and efficient work) and customers' satisfaction.

BDM auspiciously leads firms to more personalized offers for customers by managing the internal environment, which also drives higher sales. If business authorities are enabled to manage big datasets, then they can find out more information about customers' needs and wants to offer the best products and services and use powerful promoting techniques. On the contrary, privacy is considered one of the critical ethical issues that are inescapable while discussing the significance of big data and its management, if BDM is not appropriate, then the lack of privacy reflects ineffective organizational performance, which ultimately discourages consumers from buying (Kaisler et al., 2013).

## 3. Research design and methodology

### 3.1. Research philosophy

Research philosophy refers to identifying the nature of the study, for which different techniques of pragmatism, realism, and positivism are present. The selection of the appropriate research philosophy contributes to presenting a proper pattern and platform for the research, based on which the entire study is developed

(Creswell & Poth, 2016). Pragmatism refers to including different perspectives for analyzing a particular concept (Rossi, Wright, & Anderson, 2013). Realism is the research philosophy that is based on scientific techniques, which are associated with the realistic aspects and independent beliefs in a study (Ashforth & Mael, 2003). Positivism is related to performing the research study through the implementation of scientific techniques by involving the procedure of testing hypotheses (Maree, 2007). The present research is focused on utilizing positivism by including scientific methods for analyzing the research questions that have been developed. This would help in concentrating on authentic information through the use of scientific testing, which would depict relevant results as well.

### 3.2. Research design

The research design of the study contributes to defining the entire strategy that is selected for integrating several parts of the research to flow in a proper manner, which further helps in effectively identifying the problem addressed in the study. The generally used research designs for conducting different studies involve exploratory, explanatory, and descriptive. The exploratory research design is used to understand a concept, which has not been previously understood in a proper manner (Creswell & Poth, 2016). The explanatory research design refers to highlighting and studying the causal association among a defined set of two variables. This concentrates on observing which factor of defined variables causes what outcome (Malhotra, 2011). The descriptive research design contributes to further expanding and understanding a concerned topic, which has been minimally defined or portrayed. This research design is utilized for identifying the features of either the population or the concept that is being studied in research. This contributes to describing the features and not focusing on the primary cause of how particular characteristics have occurred. The present study has been descriptive in which causal relationships were inferred indirectly.

### 3.3. Method and tools of data collection

Relying on the research approach and objectives, it was essential to select the most appropriate method of data collection because it assists in generating influential outcomes of a study. Thus, a quantitative method was selected, which could provide a thorough understanding of the subject. These data were gathered by involving participants from the retail sector in Singapore. The primary tool chosen to collect first-hand information was the close-ended questionnaire that contained relevant questions based on research aim and objectives. Besides, the administering of survey questions based on the preparation and distribution of a list of comprehensible (in terms of English grammar), relevant, and appropriate questions to assist participants in responding efficiently regarding the subject matter. Similarly, the close-ended survey questionnaire was presented to the respondents with Likert Scale options.

### 3.4. Population and sampling

The selected sample size for this research was 500 respondents, who were stakeholders of retail businesses in Singapore (i.e., management staff, workers, and customers). Participants were aware of the BDM within the sector and associated changes and challenges. For selecting participants, this study consisted of a convenience sampling technique, in which all the interested and knowledgeable people were asked to participate in the survey (Kothari, 2004; Teddlie & Yu, 2007). An inclusion criterion was set

for participants that they should have knowledge and experience of big data applications and business implications.

### 3.5. Method of data analysis

Data analysis is one of the most significant steps of a study because it verifies the research hypothesis or answers the research questions with evidence. Generally, data analysis methods are selected based on the nature of the topic and approach employed earlier (Perrier, Flori, & Bonnot, 2003, pp. 31–63). For instance, qualitative data are analyzed through subject methods that include content analysis, thematic analysis, and descriptive analysis (Smith & Firth, 2011). Conversely, the quantitative study integrates statistical tools such as Microsoft Excel, E-views, and Stata, and so on (Joffe, 2012) to manage and analyze information based on the descriptive and inferential analysis.

Considering these facts, the present study also focused on the specific and appropriate method of data analysis. As the present study is reliant on quantitative methods; thereof, data initially has been analyzed through statistical software (i.e., SPSS), which helps in evaluating and interpreting responses gathered through a questionnaire in terms of inferential tests, regression, and descriptive statistics (Ott & Longnecker, 2016; Vaismoradi, Turunen, & Bondas, 2013). It proved efficient to generate authentic outcomes, as SPSS is primarily used for quantitative data analysis.

#### 3.5.1. Validity and reliability

Based on actions undertaken for avoiding ethical issues, the present research includes the internal validity (where requirements of following scientific research methods of a study are essential (Bapir, 2012)). Thus, the appropriate time scale, methodology, and sample size have been key indicators of the current study. However, the reliability of the study is external because it determines that this research can be easily replicated (Bapir, 2012). Therein, it has been ensured that results obtained through the close-ended questionnaire are credible.

## 4. Findings and discussion

This section aims to address research questions that had been devised in the introduction section. This research employs a survey to gather information from participants. To analyze the numerical data obtained from participants, the researchers used SPSS version 21.

### 4.1. Descriptive statistics

The table below identifies the normality of the data. Data in Table 1 show that all mean values are larger than standard deviation values. This indicates that data are normally distributed and are not dispersed.

### 4.2. Analysis of research questions

Participants of the study were asked if the organization they are currently employed in focuses on the use of big data. It was observed that the majority of participants belonged to organizations that were using and dealing with big data, as it is shown in Table 2.

Participants of the study were asked about how long their companies have been involved in using Big Data Management. It was observed that the majority of the participants working in the organization had been involved in the usage of BDM for around a year, whereas 160 participants mentioned their companies had

**Table 1**  
Descriptive statistics.

Descriptive Statistics (N = 500)		
	Mean	Std. Deviation
Organization_BDM	1.20	.404
long_using_BD	1.80	.808
Different_BD	2.04	.699
Feasibility1	1.78	.545
Feasibility2	1.56	.907
Impact_organization	2.92	1.047
Impact_Customer	3.02	1.097
Strategies_managing_BD	1.78	1.148
Methodology_managing_BD	1.76	.916
Reducing_barriers	2.32	1.220
Possible_capabilities	2.54	.788
Valid N (listwise)		

been using for two years, while 120 indicated that their companies were using BDM for three years (Table 3).

Respondents of the study were asked about the type of different big data analytics used in Singapore's retail industry. In all, 350 respondents indicated that Singapore's retail industry have been using majorly social media analytics, followed by Text Analytics, Predictive Analytics, and Video Analytics (Table 4).

Participants were asked about leading strategies and approaches that are used for managing big data in the Singaporean retail industry. It was observed that more than half of the respondents (310) projected that "Fork in the Road" strategy is commonly used followed by Blueprint strategy (160). In addition, 30 participants mentioned that the SQL-based analytic method is also observed to be used for managing big data in the Singapore retail industry (Table 5). This indicates that the majority of participants believed that "Fork in the Road" strategy and Blueprint strategy are the main strategies, and approaches that are used for managing big data possess in the Singapore retail industry.

For the aspect of strategies that manage the big data, most of the responses identified the "Fork in the Road" strategy. The questionnaire had also included the options of the blueprint strategy and the SQL-based analytic method as well. As mentioned before, the literature studies had identified the approach of traditional methods, but with aspects of issues being encountered by business ventures (Davenport et al., 2012). However, studies had identified that several business ventures in terms of the retail industry had been following the "Fork in the Road" strategy, which is the strategy selected by most of the participants as a preferable option in the conducted study (Intel, 2014). Even though the mentioned strategy has been preferred the most, the studies had identified that it is a time-consuming technique, which is why most of the organizations are associated with the standard procedures instead of being based on a particular strategy (Chen et al., 2012). However, the study performed by Russom (2011) had indicated a big data strategy to be relevant for enhancing profitability. The above studies suggest this strategy does present proper data governance and analytics that contribute to not needing to move the big data that must be managed physically.

Even so, this had included the factor of lack of information and proper measures for employing the strategy that would be

ineffectively managing the big data. This is because having reduced sales would automatically contribute to reduced profitability, and such a condition would be highly problematic for the business ventures that are within the retail industry because they could shut down in this manner. This highlights the importance of the "Fork in the Road" strategy, and results of the present study indicate the relevance of using this as an effective technique for managing the big data within Singapore.

Participants were asked about the main methodologies that are used for managing big data in the Singapore retail industry. Majority of respondents (240) projected that VLDB paradigm is commonly used, followed by a Master Data Management System. In addition, 40 participants suggested that Enterprise Data Warehouse and OLAP and Basic Reporting and Querying are also observed to be used for managing big data in the Singapore retail industry (Table 6). This indicates that majority of participants believed that the VLDB paradigm and Master Data Management System are the main methodologies that are used for managing big data possess in the Singapore retail industry.

Besides the techniques that have been mentioned above, the questionnaire comprised of particular methodologies, for which majority of participants had responded with the VLDB paradigm. This can be related to the increase in sales and profit, as defined above.

Participants were asked about their opinions related to the tools and technologies used for reducing barriers to managing big data. Majority of respondents (180) projected that hiring skilled resources in various analytics disciplines is one of the strategies that could be used for reducing barriers. However, on the other hand, 110 participants believe that training old employees is essential. In addition, 130 participants thought that the use of modern methods and software is a crucial tool for the reduction of barriers, whereas 80 participants suggested that instituting a formal analytics training plan is also useful in reducing barriers (Table 7). This indicates that majority of participants believed that hiring skilled resources in various analytics disciplines and Usage of modern methods and software are used for reducing barriers for managing big data.

For the aspect of tools and techniques that are utilized for decreasing barriers in terms of handling the big data within the

**Table 2**  
Organizations currently deal with big data.

		Frequency	Percent
Valid	Yes	400	80.0
	No	100	20.0
	Total	500	100.0

**Table 3**  
Experience using big data management.

		Frequency	Percent
Valid	1 Year	220	44.0
	2 Years	160	32.0
	3 Years	120	24.0
	Total	500	100.0

**Table 4**  
Big data analytics used in Singapore's retail industry.

RQ 1: What are the main strategies and approaches that are used for managing big data possess in the Singaporean retail industry?

		Frequency	Percent
Valid	Text analytics	80	16.0
	Social media analytics	350	70.0
	Predictive analytics	40	8.0
	Video analytics	30	6.0
	Total	500	100.0

**Table 5**  
Strategies and approaches used for managing big data.

		Frequency	Percent
Valid	"Fork in the Road" strategy	310	62.0
	Blueprint strategy	160	32.0
	SQL-based analytic method	30	6.0
	Total	500	100.0

**Table 6**  
Main methods that are used for managing big data.

RQ 2: What are the tools and technologies used for reducing barriers to managing big data in the Singapore retail industry?

		Frequency	Percent
Valid	Very Large Data Bases (VLDB) paradigm	240	48.0
	Master Data Management System	180	36.0
	Enterprise Data Warehouse	40	8.0
	OLAP and Basic Reporting and Querying	40	8.0
	Total	500	100.0

retail industry of Singapore, majority of responses from participants indicate the method of hiring skilled resources in various analytics. This could be related to the study performed by [Chen and Zhang \(2014\)](#), because it identified the factor of irrelevant staffing and associated skills in specific. This relates to the immature behavior that is depicted by the authorized entities to manage the different types of data and the human and capital resources. [Chen and Zhang \(2014\)](#) had further indicated factors of technology and incongruous infrastructure as problematic barriers in terms of managing big data within the retail industry. The mentioned study had focused on methods for eliminating obstacles, along with the concentration on problematic barriers as well because the mentioned factors have been regarded as prime barriers concerning the retail industry. This is because the retail sector encounters such challenging obstacles for big data management.

**Table 7**  
Tools and technologies used for reducing barriers for managing big data.

		Frequency	Percent
Valid	Hiring skilled resources in various analytics disciplines	180	36.0
	Training old employees	110	22.0
	Instituting a formal analytics training plan	80	16.0
	Usage of modern methods and software	130	26.0
	Total	500	100.0

RQ 3: What possible competencies can arise from data analytics tools for managing big data in retail practices, especially in relation to the retail environment in Singapore?

The participants were asked about their opinions related to the possible competencies that arise from the use of data analytics for big data management. Majority of respondents (210) projected that it could offer mass customization and customization marketing. However, on the other hand, 200 participants believe that the identification of valuable customers and strategies used in retaining them is another possible capability that could arise from the use of data analytics for big data management. In addition, 50 participants believed that it possesses abilities of Predictive Analytics of customer behavior, whereas four believed that it could help in devising a clear business strategy ([Table 8](#)). This indicates that



**Table 8**

Possible competencies from data analytics tools for managing big data.

		Frequency	Percent
valid	Clear business strategy	40	8.0
	Identify valuable customers and strategies of retaining them	200	40.0
	Mass customization and/or customization	210	42.0
	Predictive Analytics of customer behavior	50	10.0
	Total	500	100.0

**Table 9**

Impact on organization performance.

		Frequency	Percent
Valid	Improve operational efficiency	80	16.0
	Capabilities to improve business agility	50	10.0
	Higher number of sales	200	40.0
	Reduced cost	170	34.0
	Total	500	100.0

majority of participants found that mass customization or customization marketing and the identification of valuable customers and strategies of retaining them are capabilities that arise from the use of data analytics for big data management.

For the aspect of possible capabilities and competencies that could be depicted from data analytics tools to handle big data, most of the participants had selected the option of mass customization or customization marketing. However, in comparison with the capability of identifying valuable customers and strategies in retaining them, there was a difference of one response only between two mentioned options. In the literature section, a related study (Russom, 2011) had indicated that mass customization or customization marketing is an essential capability in the context of the retail industry, which can be associated with the responses of the present study. BDM contributes to presenting the retail industry of Singapore with a different capability concerning the process of operating and depicting just as shopkeepers, in which case they would be aware regarding several other consumers in a personal manner.

RQ 4: How does the use of Big Data affect organizational performance and customer satisfaction in the retail industry of Singapore?

The participants were asked about their opinions related to the BDM analytics in terms of organizational performance for the Singapore retail industry. Majority of respondents (200) projected that higher number of sales is one of the benefits in terms of organizational performance for the Singapore retail industry, followed by reduced costs. In addition, 80 participants suggested that improvement in operational efficiency is also observed along with capabilities to improve business agility (Table 9). This indicates that majority of participants believed that a higher number of sales and reduced costs is a benefit in terms of organizational performance for the Singapore retail industry by using Data Management

Analytics (see Table 10).

For the aspect of the impact of big data on the organization's performance, most of the participants had presented responses for higher number of sales. The present study has indicated that there is an increase in the name of sales as an essential outcome concerning the influence of BDM on the organization's performance. This has been identified in comparison with aspects of reduced costs, better operational efficiency, and more capabilities for enhancing business agility. However, the literature section has indicated that based on the Ernst and Young report (2014), it depicted the factor of relevant management in terms of increased production with respect to increased demands of customers as well.

The mentioned report focused on the impact regarding demands of customers in association with increased production. The Ernst and Young report (2014) did not present relevant theoretical aspects that would have contributed to defining the association between BDM and customer satisfaction. This aspect was identified by the study performed by Paradigma (2015) by indicating that both the factors are correlated to each other because in specific to the identified study, it was focused on a hotel. The correlation had shown the hotel management to enhance customer satisfaction through the course of attaining their trust by presenting standard quality and services based on on-time effectiveness. This aspect can be related to the following results that have been obtained by the present study.

Participants were asked about their opinions related to the BDM analytics in terms of customer satisfaction for the Singapore retail industry. Majority of respondents (220) projected highly satisfied customers as one of the benefits in terms of customer service for the Singapore retail industry, followed by future-derived patterns of customer demands (150). In addition, 80 participants suggested that improved customer insight is also observed along with capabilities to understand preferences of customers. This indicates that many participants believed that highly satisfied customers and

**Table 10**

Impact on customer satisfaction.

		Frequency	Percent
Valid	Improve customer insight	80	16.0
	Preferences of customers	50	10.0
	future-derived patterns of customer demands	150	30.0
	Highly satisfied customers	220	44.0
	Total	500	100.0

future-derived patterns of customer demands are a benefit in terms of customer service for the Singapore retail industry by using Data Management Analytics.

In terms of the impact of BDM on customer satisfaction, most of the participants had indicated that there had been highly satisfied customers. This can be associated with the above-described studies that have related the factor of customer satisfaction and BDM concerning the aspect of developing trust in this context. The element of a highly satisfied customer was depicted significant in comparison with the improvement of customer insight, future patterns regarding the demands of the customers, and preferences of the customers. This means that the latter factors were not as much influenced as the factor of customer satisfaction had been affected, as highlighted by most of the responses in the performed study for the area of Singapore. In another related study (Jewell et al., 2014), it identified that big data contributes to different customers for being involved within various activities in the organization and be known to the legal and illegal activities that might be associated, for example, fraud and corruption. By being unaware of the illicit activities that might occur within an organization, it would decrease the chances of the business venture of being associated with such objectives that target and help in retaining customers.

## 5. Conclusions

The impact of big data on the organization's performance involves an increase in higher sales, as per the results of the conducted study. The reduced cost had also been indicated, but more responses had been in favor of a higher number of sales. In the case of the impact on customer service, highly satisfied customers had been observed. This had been further supported by the literature studies, as different studies had also depicted the same results in this context. The study had further described "Fork in the Road" strategy as an essential approach utilized for managing big data and VLDB paradigm as the main methodology to be used. In terms of reducing barriers within the aspect of big data management, the course of hiring skilled resources within various analytics had been selected by most of the participants. In addition, for the platform of possible competencies, mass customization or customization marketing had been depicted.

The results of the study indicated that majority of participants agreed with most organizations dealing with big data in present times. The results further identified that among the different big data analytics utilized within the retail industry of Singapore, the social media analytics had been majorly answered by participants. The study identified that the moderate feasibility of BDM analytics is present within the retail industry of Singapore. The participants had indicated a lack of skilled workers as an essential factor in terms of its direct relation to the feasibility of big data management. The literature studies identified the aspect of traditional methods in this context, but this was related to the manual processing that would initiate problems for the authorities within the industry.

Future researchers can study about the upcoming retail trends in Singapore and how effects of big data analysis changed in the past few years. Also, economic feasibility that is based on resources of the region and tools of management employed by the industry to manage big datasets and deal with unexpected future recessions in the retail industry within Singapore can be considered in future studies. In addition, this study could also be replicated by future researchers, examining the evolution of this phenomenon. Besides this, using a comparative study, this research could be conducted with reference to different cities and countries.

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