A Multidisciplinary Perspective of Big Data in Management Research

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ABSTRACT

In recent years, big data has emerged as one of the prominent buzzwords in business and management. In spite of the mounting body of research on big data across the social science disciplines, scholars have offered little synthesis on the current state of knowledge. In this paper, we developed an integrated framework to link the multiple streams of research in fields of organisation, operations, marketing, information management and other relevant areas. Our analysis demonstrates how both structured and unstructured big data has been harnessed to inform organisational decisions and improve firm competitiveness. The review also indicates that big data has also unleashed novel challenges in term of security and privacy of personal data. In light of these, the study identifies and outlines the implications and directions for future research.

KEYWORDS: Big data, Management research, Literature review.

1. INTRODUCTION

Since the turn of the 21st century, big data has become increasingly prominent in not only transforming the business models, but also paving the way for organisational strategic decision-maker to act in a timely manner (Beath et al., 2012; McAfee and Brynjolfsson, 2012; Papadopoulos et al., 2017). In the age of the Internet of Things, more data are generated and recorded on daily basis and the term "big data" has emerged to represent the large data pool with significant variety and complexity (see Manyika et al., 2011; Wang, Gunasekaran, Ngai & Papadopoulos, 2016). In recent years, big data has emerged as one of the prominent buzzwords in business and management. Past studies have demonstrated the value of big data in enhancing productivity and creating social surplus (Manyika et al., 2011). It has also helped to improve making-decisions with better accuracy based on solid data evidence rather than intuition (McAfee and Brynjolfsson, 2012). In addition to technological improvements to capture and store big data, practitioners and academics have been exploring further implications of big data for business and management (Wamba et al., 2017).

Despite the growing recognition of the importance of big data across industries and sectors (Gandomi and Haider, 2015; Papadopoulos et al., 2017) and growing body of knowledge (McAfee and Brynjolfsson, 2012; Wamba et al., 2017), there is limited synthesis of the literature across the social science disciplines. Indeed, the lack of clarity in current research on big data may stems from a lack of a comprehensive review to clarify boundaries of the subject and progress made by scholars (see Gunasekaran, Papadopoulos, Dubey, Wamba, Childe, Hazen & Akter, 2017). Furthermore, the lack of interdisciplinary research review may have obscured the past accomplishments leading to lack of clear directions for future research. Against this backdrop, the main purpose of this study is to review the literature on big data in business and management research, in order to identify the key themes in current big data research and clarify the research frontiers. The review intends to serve as a reference point to advance big data research in management fields.

The article offers several contributions to big data, business and management research. First, a few scholars have suggested that an integrated approach to big data can enhance our understanding of the subject (see Amankwah-Amoah, 2015, 2016), but to date the literature remains scattered across disciplines. In this direction, our paper contributes to the literature by offering a comprehensive review of the literature, which clarifies the complexities of the subject, management applications of big data, current trends and themes identified by past studies. Further, we extend prior scholarly works (Gunasekaran et al., 2017) by developing an integrated framework to link the current disjointed streams of research. In addition, building on past studies (Hazen et al., 2016; Gunasekaran et al., 2017; Wang et al., 2016), the paper also synthesises the literature from various perspectives in business and management, highlighting primary concerns in each academic field. In so doing, we outline the linkages between the approaches adopted by scholars in areas such as organisation, operation, marketing, and information management with regard to big data application. Furthermore, by explicating the mechanisms and approaches adopted by scholars, we outline an approach towards better utilisation of big data in business and management domain.

The rest of paper is organised as follows. The next section outlines the evolution of big data research and clarifies the scope of this review. This is then followed by development of an integrated framework drawing on various management perspectives. The last section discusses the research gaps and promising avenues for future research.

2. EVOLUTION OF BIG DATA

2.1 What is Big Data?

Some scholars have suggested that big data is a "moving definition" which varies with time as well as industrial sectors (Manyika et al., 2011, pp. 1). There is no fixed threshold set for measurement of what size and type of data can be treated as big data, given that the amount continues to increase. Indeed, the quantification of data takes different forms and different datasets may generate depending on various analytics forms. Although there is no universal definition of big data, there appear to be

an emerging consensus about its uniqueness that distinguishes big data from what we recognise as large database. Three Vs of big data, namely volume, variety and velocity, has been introduced at an early stage of the development of this notion (see Laney 2001; Kwon et al., 2014; Russom, 2011; Gunasekaran et al., 2017). In addition to scale expansion, big datasets are far more complicated. Data is generated and collected from more diversified sources such as web sites, smart devices and social media.

Moreover, data variety is greater because data comes in all types of formats. Structured data is no longer the only type we recognised, rather more unstructured and semi-structure data are identified as conveying abundant useful information. Furthermore, torrents of data are coming in near-real time (Papadopoulos et al., 2017). The speed of data generation and data delivery become critical elements in big data especially the high-frequency streaming data in real-time decision-making. Additional characteristics of big data include high value, high veracity and high variability (see Gandomi and Haider, 2015; Katal et al., 2013).Given the confusions over big data concept, we define big data as extremely large amount of structured, semi structured or unstructured data continuously generated from diversified sources, which inundates business operations in real time and impacts on decision-making through mining insightful information from rambling data. For research clarity, what constitutes big data in this study include large structured datasets and unstructured data in the form of text (e.g. documents, natural language), web data (e.g. web structure, web usage, web content), social media data (e.g. virtual network), multimedia data (e.g. image, audio, video), mobile data (e.g. sensor, geographical location, application).

2.2 Big Data in Practice

In real-world practice, the abundance of big data has accelerated largely due to technology improvements. In recent decade, more advanced platforms and systems have been invented and utilised to handle big data, which have advantages compared to traditional techniques in every aspect of data management and analytics. Russom (2011) foresees a future trend towards a growth in the

adoption of visualisation, in-memory databases, SQL and other advanced analytics techniques in corporate IT commitment. As big data expands, new advanced techniques with superior functionality and flexibility will become more in demand to make business analytics more cost-effective and efficient.Nowadays, big data analytics has become a trendy practice in business intelligence encompassing combination of massive data sets and advanced analytics techniques, and it plays a role in influencing aspects of business activities and customer choice (Russom, 2011). With extensive amount of data collected and interpreted, companies are able to identify the competitions and respond to customers' requirements. The majority of the global economies and business activities are expected to be involved in some kind of big data transformation (McAfee and Brynjolfsson, 2012). The diversity of big data has been regarded as "enterprise assets" which can "yield actionable business insights" (Russom, 2011, pp. 9).

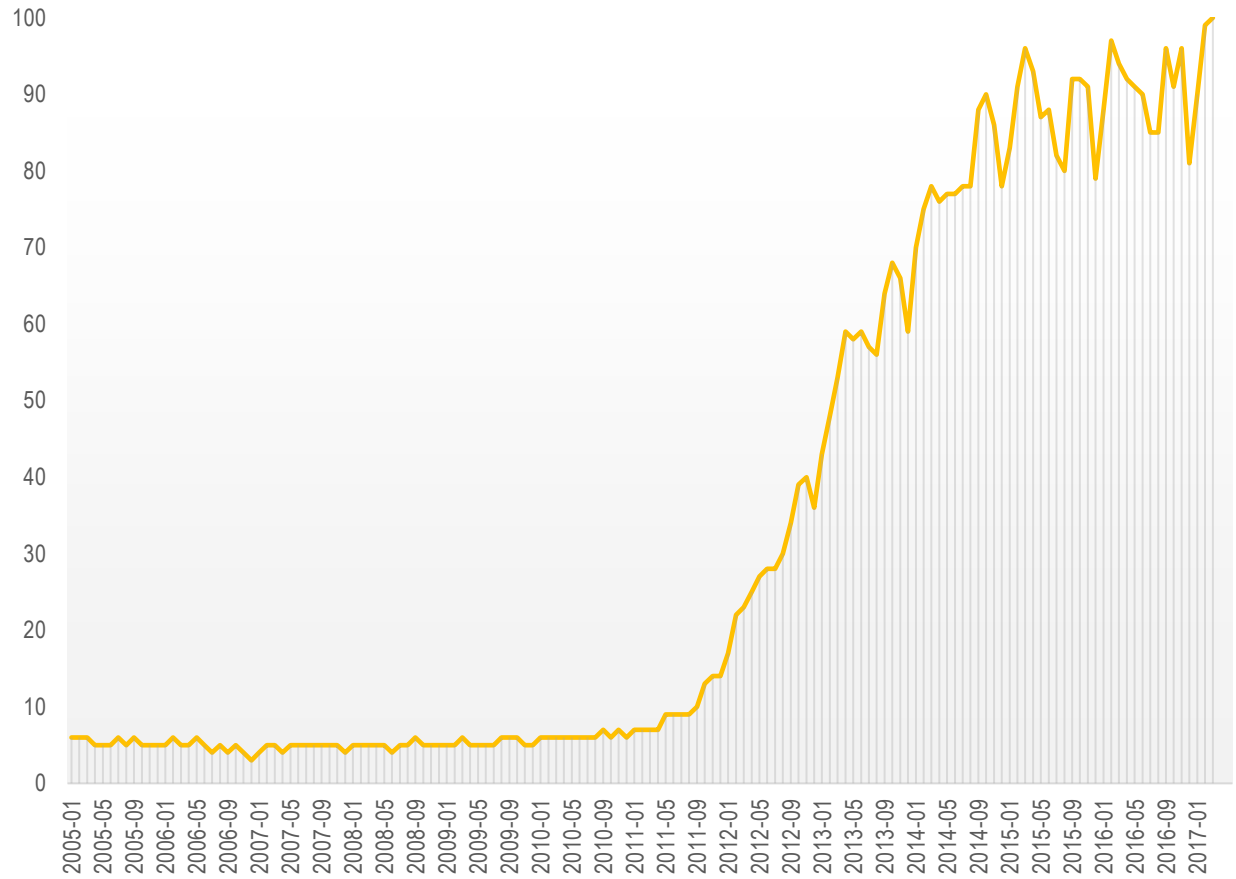
With better accuracy in prediction based on solid data evidence instead of intuition and experience, the data-driven approach is capable to improve business performance (McAfee and Brynjolfsson, 2012). With promising development and technological support, big data is becoming increasingly needed and emphasised in modern business operation. Indeed, there is strong evidence indicating data is an essential element for firms seeking to gain competitive advantage (Brown et al., 2011). It has potential to play a significant role in countries' development, academic research, and the way people see the present and the future world (Jin et al., 2015). Within organisations, managerial perceptions and process are also changing along with a data-driven decision-making strategy, which leads to changes in organisational culture, leadership, human resource management and other management practice (Davenport, 2014; Rifkin, 2014).

Additionally, significant impacts of big data can be seen in strengthening customer relationships, lowering management risk, improving operation efficiency, which leads to more effective marketing strategies and operation management to gain competitive advantages (Kiron and Bean, 2013). Facing great potential of big data, a clear path towards business and management improvement is an urgent

need. By revealing current research state and issues addressed in prior studies, this paper seeks to identify the big data evolution in management academia and fruitful future research opportunities. For researchers and practitioners, the emergence of big data has led to greater enthusiasm for 'discovering the strategic uses of large database' (Bollier and Firestone, 2010, pp. 1). A growing number of publications and industrial reports addressing business intelligence, business analytics, and big data issues have emerged. Nonetheless, there remains considerable research space to address big data challenges, particularly in the aspect of linking big data with application disciplines in knowledge economy and management domain.

3. METHOD AND SCOPE OF THE REVIEW

In order to capture wider coverage of the existing literature, we followed the approaches used by Chen et al. (2012) and the best literature review approach (e.g. Short, 2009; Webster and Watson, 2002). We started by using key words such as "big data", "big data analytics", "text analytics/analysis", "web analytics", "social media (analytics)", "mobile analytics", "big data and predictive analytics (BDPA)", "data analytics", "volume of data", "variety of data", and "velocity of data", which have all been used by past studies to refer to some kind of big data to search digital databases such as Business Source Complete, Google Scholar, Scopus, Informs, Sage, Wiley, JSTOR, ScienceDirect, Springer and Emerald. This enabled us to identified large number of articles in the broad area of big data. We also followed up references from the articles to identify additional studies. The initial search yielded a large number of articles in the broad area of big data. We carefully scanned for relevance and used combinations of keywords (e.g. "big data" and "text analysis") to exclude studies that were not closely link or utilise big data. Searching the term "big data" on Google Scholarly returns millions of results, which span multi-disciplines, such as computer science, engineering, and social sciences. People are getting interested in big data, especially starting from the year 2011, according to the statistics of popularity for this term on Google Search (see Figure 1).



Notes: The statistics shows worldwide search interest of the term over the period from 2005 to March 2017.
Source: Google Trend.

Figure 1. Popularity of Term "Big Data" on Google Search

In total, over 300 articles that had a clear focus on big data with management implications were selected for further analysis. We then read and examine the selected articles in details. The final sample included 284 articles. All sampled articles were downloaded and analysed. We recorded the authors, year, titles and journals of publications. Each article was coded according to several predetermined variables, such as type of research paper (e.g. empirical, conceptual), subject of journals (e.g. general management, marketing), and analytics category (e.g. big data analytics, text analytics) in order to describe the characteristics of the sample. By analysing the content, we also identified the specific topic and scope of each article. Based on the review and synthesis of the literature, we deduced the following insights.

3.1 Big Data in Business and Management Research

3.1.1 Distribution of articles by year of publication

With regards to timeline, scientific research around "big data" started to gain prominence this century. Majority of studies on the subject were conducted within technology-related disciplines, while the discovery of big data's business implications somehow lagged behind. However, the analysis shows a growing number of publications addressing big data issues in the management community. From 2005 to early 2017, there has been a surged in the number of articles on the subject. As illustrated in Figure 2, management-related research on big data grew exponentially over the review period, especially after the year 2011. This is in line with the upward trend of the overall interest in the term "big data" in the past decade.

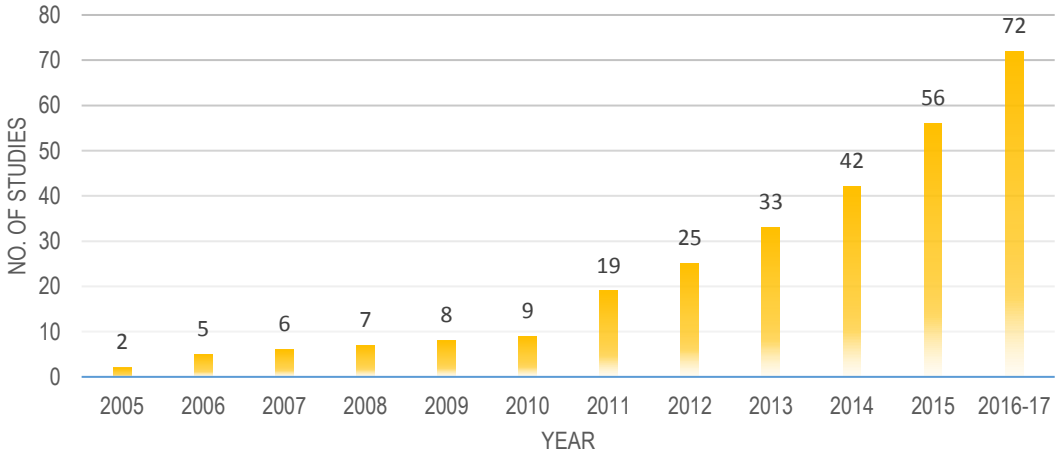


Figure 2. Distribution of Articles by Year of Publication

3.1.2 Distribution of articles by research paper type

The type of papers is classified based on the primary research methodology used in the studies. **In this review, it is found that empirical and modelling studies take up the majority, while only a**

small proportion of paper are conceptual. In addition very few studies have adopted qualitative approach. Empirical studies investigating big data related issues relying mainly on observation and experimentation, while modelling papers have sought to improve existing systems and propose new approaches. As show in the first chart in Figure 3, these two methods are adopted in 84% papers of total. For the rest, 10% are theoretical and conceptual papers, which discuss issues, centred on the topic and contribute to development of theoretical frameworks. Literature review and case study account for only a small minority (6% together), with a focus on research or organisations that apply big data approach. The distribution reveals the importance of solving technical issues at a fundamental level of the development in this area. It is reasonable as the rise of big data is meant to optimise data-driven concepts and approaches. Once the big data techniques are loud and clear, it leads to investigation into business related issues to realise business values and inter-organisational changes. Then a complete system of big data in management research is expected to be built and advanced based on the practically applicable models and theoretical frameworks.

3.1.3 Distribution of articles by subject

Regarding the distribution of articles, we identified eight broad subject areas, namely general management, information management, marketing, operation research and management science, organisation, sector study, public sector study and others. This classification is based on the journal in which the article published and the subject that the journal belongs to in the Academic Journal Guide 2015 (The Association of Business Schools, 2015). Among the reviewed papers, 46% relates to information management subject (see the middle chart in Figure 3). This may stem from the fact that information management is more data and technology-based, which accords with the nature of big data. Most of these papers seek to introduce or improve approaches to process data with different analytic and managerial goals. In addition, marketing (18%) and operation research (17%) have also published considerable amount of papers, exploring the effectiveness of big data driven approach in marketing activities and operational practices. Meanwhile, there are relatively few articles in current

studies considering big data from an organisational (7%) or broader managerial perspective (10%), emphasising the strategic importance of big data. This indicates an imbalance among different subjects, and big data research remains underexplored in several management areas.

3.1.4 Distribution of articles by analytics category

The study uncovered that scales of structured and unstructured data can be used in analytics to improve management effectiveness. Unstructured data appeared in present studies include text data, web and multimedia data, social media data, mobile and sensor data. Based on what data each article analyses or what analytics it focuses on, we categorise the selected papers into six types, namely big data analytics, text analytics, web analytics, multimedia analytics, social media analytics, mobile analytics (see the last chart in Figure 3). An important fact demonstrated from the statistic is that unstructured data becomes attractive to researchers in recent years' study. In our sample, 18% of papers discuss big data analytics in general or analyse large-scale structured data, while the remaining emphasises the importance of unstructured data in management application.

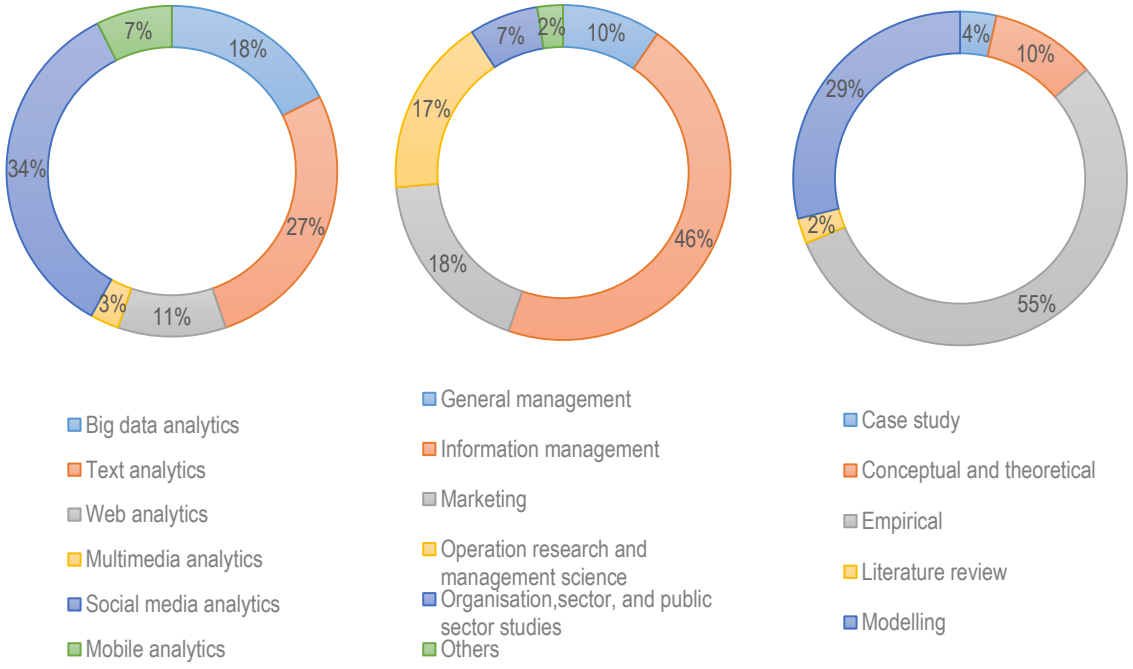


Figure 3. Distribution of Articles by Research Type, Subject, and Analytics Category

Text analytics is a prominent area (27%) with proposing methods to extract and analyse textual data. 98 articles (34%) are related to social media, where social networks deliver insightful messages. The fact that text analytics and social media analytics are more popular may stem from easy accessibility of the data sources such as social media platforms, websites, and blogs. Indeed, there is some overlap between these two types as textual data is one main form of social media data. In general, most text-based analysis aims at technical improvement, knowledge discovery and opinion mining, while social media related studies further concern human behaviour, social influence, and digital business issues.

In addition, web analytics is a likewise hot topic, with 10% of papers addressing web mining and other Internet-based issues using web logs, clickstream, web pages and other data. In contrast, alternative types of data such as multimedia, mobile and sensor data are rarely seen in literature. There are 21 articles (8%) in our sample covering mobile analytics issues, while multimedia data is even rarer in our observation with only 8 articles relevant (3%). These data are also being generated and collected in a tremendous scale. Nevertheless, it is yet not clear for management researchers and practitioners how to use them effectively.

4. BIG DATA: AN ORGANISING FRAMEWORK

The present study indicates that there are various perspectives to see big data issues in the management community, including organisation, operations, marketing and information management. To deepen our understanding of the vast literature, a content-oriented classification is applied to capture article themes with a few paradigms. The clustering of literature is based on the specific topic and application area of big data that each article spotlights. This information is extracted and coded from article keywords and further analysis of the whole study. All codes generated are then grouped into 25 categories, where each category indicates the central topic of the articles, or the main application area the studies aim for. There upon all categories are further organised into five main perspectives, from which management researchers are looking into big data issues in the existing literature. We then investigate what problems have been addressed within each perspective and key

findings from their studies. Table 1 presents the summary of all the reviewed articles and the classification scheme in this paper.

Table 1. Distribution of Articles by Topic and Application Area

Perspective	Topic and application area		No. of studies	
Organisation	Organisation strategy	Business intelligence	20	
		Strategic management	7	
	Organisation management	Organisational change	5	
		Organisation engagement	8	
	Human resource management		7	47
Operation and production	Operation management	Operation process	7	
		Production and innovation	6	
		Operation research	1	
	Supply chain management		10	24
Marketing	Consumer behaviour	User behaviour	17	
		Online community	6	
		Social network	7	
	Consumer sentiment	Online review	28	
		Online rating	7	
		Sentiment analysis	23	
	Marketing strategy	Advertising and targeting	17	
		Brand analysis	12	
		Electronic word-of-mouth	15	
		Market analysis	12	
		Recommendation	12	156
Information management	Technique and analytics issues		31	31
Others	Accounting and finance		8	
	International business		2	
	Public administration		12	
	Others		4	26
Total				284

The clustering of articles reveals a disperse distribution among different subjects. First, understanding consumers seems a primary direction in present research. These studies mostly involve analysing text, social media data, mobile and sensor data for marketing and operation purposes. Consumer sentiment and behaviour are examined in various ways, taking into account of social influence and specific natures of online shopping environment. Second, from a strategy perspective, prior studies explore the strategic use of big data in the digital business environment. New strategies in marketing, operation and other areas are attempted to improve business efficiency. A handful of papers overview

big data's impact on strategic decision-making, and the changes it leads to organisation management and organisational functions are also discussed. Third, papers in information management field mainly deal with analytics techniques and technological issues. It helps improve information retrieval and data process with better accuracy and efficiency, and therefore support research needs in other management fields. Moreover, operation management, production and innovation, supply chain management are investigated in several researches. A primary goal of these studies is to enhance operation efficiency and effectiveness by leveraging information delivered by big data. In addition, from other aspects, though seldom, scholars in accounting, international business, public sector study and other areas turn their attention to big data's potential for creating values so as to advance research in data rich future.

4.1 Organisation Perspective of Big Data

The organisation studies' perspective on big data examines the organisation alignment with data-driven strategy in every aspect of organisational structure, culture, operation, and functions. It emphasises the potential changes in organisational ecosystem and management process under the influence of big data strategy. Table 2 summarised articles taking this perspective.

Table 2. Organisation Perspective of Big Data

Organisation perspective		**Studies**
Organisation Strategy	Business intelligence and firm performance	Akter et al.(2016); Castellanos et al.(2012); Chen et al.(2012); Côrte-Real et al.(2017); Dutta and Bose(2015); Erevelles et al.(2016); Gupta and George(2016); Janssen et al.(2017); Luo et al.(2013); Martens et al.(2016); Matthias et al.(2017); Menon and Sarkar(2016); Ren et al.(2016); Sabnis and Grewal(2015); Sivarajah et al.(2017); Toubia and Netzer(2017); Vila and Gomez(2016); Wamba et al.(2017); Xie et al. (2016); Xu et al. (2016)
	Strategic management	Bharadwaj et al.(2013); Bhimani(2015); Opresnik and Taisch(2015); Saboo et al.(2016); Wamba et al.(2015); Woerner and Wixom(2015); Yuan et al.(2016)

Organisational management	Organisational change	Braganza et al.(2017); Gunasekaran et al.(2017); Kiron and Bean(2013); McAfee and Brynjolfsson(2012); Orlikowski and Scott(2014)
	Organisational engagement	Dellarocas (2006); Dijkmans et al. (2015); Gu and Ye(2014); Hu et al. (2012); Miller and Tucker(2013); Tripp and Grégoire(2011); van Noort and Willemsen(2012); Vermeulen and Seegers(2009)
Human resource management		Kluemper and Rosen(2009); Lam et al.(2017); Marcus et al. (2006); Roth et al.(2013); Shah et al.(2017); Tambe (2014); Van Iddekinge et al.(2016)

4.1.1 Organisation strategy

From an organisational strategic perspective, present researches discuss the impact of big data on business intelligence and strategic management.

Business intelligence. Bollier and Firestone (2010) points out that big data provides numerous interesting correlations, among which the significant correlations can be used to discover and establish the causality with models. For instance, firm performance in a competitive environment is significantly correlated to user-generated content (Sabnis and Grewal, 2015), and in another way around, social media metrics significantly indicate firm equity value with stronger and faster predictive relations than traditional online behavioural metrics (Luo et al., 2013). Such business intelligence is acquired by performing big data analytics, which combines big data with advanced analytics techniques to extract valuable insights from big data (Chen et al., 2012). It advances a firm's business intelligence capability, for example, streaming unstructured web data in near real time improves enterprises' situational awareness thus operational business intelligence (Castellanos et al., 2012). Indeed, big data analytics is becoming an essential element in organisation for gaining success (Dutta and Bose, 2015). It endows firms with advanced business intelligence capability (Castellanos et al., 2012; Chen et al., 2012) and insights from big data metrics are more rigorous (e.g. Bollier and

Firestone, 2010; Luo et al., 2013; Sabnis and Grewal, 2015). Decisions enlightened by big data can be more effective with greater flexibility and promptness (e.g. Bhimani, 2015; McAfee and Brynjolfsson, 2012; Wamba et al., 2015).

Strategic management. A parallel interest in the subject has emerged among strategy scholars. Hitt, Ireland and Hoskisson (2011, pp. 6) defined strategic management as "the full set of commitments, decisions, and actions required for a firm to achieve strategic competitiveness and earn above-average returns". From strategic management perspective**,** big data is increasingly admitted as enterprise assets, which is critical to organisational success (Russom, 2011; Dutta and Bose, 2015). The strategic management perspective on big data focuses on how resources and capabilities are assembled and utilised to help firm make quality future and long-term decisions (see Hitt et al., 2015; Ireland et al., 2012). Big data analytics has great impact on strategic process and improves consequent decisions by providing new data, insight and action. Especially big data shows a broader view on the information flow that comprehensively reflects the potential changes in business operation in real-time (Bhimani, 2015). Thus, it enables executives to extend their knowledge about the business and enhance the effectiveness and flexibility of strategic decisions in a timely, efficient manner (McAfee and Brynjolfsson, 2012).

Moreover, big data can improve business model innovation through data monetisation and digital transformation (Woerner and Wixon, 2015). For example, digital business strategy, a fusion between IT strategy and business strategy, may have greater insights by considering its scope, scale, speed and sources of such strategy (Bharadwaj et al., 2013). More importantly, the profound impact of big data is expected to be seen on organisational strategic transformation (Provost and Fawcett, 2013), and it may reshape the operational mechanism within the organisation as well as its strategic actions (Beath et al., 2012; Mayer-Schönberger and Cukier, 2013). With such data-driven business models emerging, it requires organisation to embrace big data and adopt advance information system to improve the

effectiveness and flexibility of decision-making process to achieve better performance (Wamba et al., 2015).

4.1.2 Organisational management

Organisation change. Within an organisation context, adopting big data-enabled decision-making strategy has made great influence on organisational management (Rifkin, 2014). Such change is achieved via 'transforming processes, altering corporate ecosystems, and facilitating innovation' (Brown et al., 2011, pp. 26) and it has already generated new managerial perceptions. Undoubtedly, there will be a transition of managers' views on "the value of experience, the nature of expertise, and the practice of management" (McAfee and Brynjolfsson, 2012, pp. 4). Kiron and Bean (2013) also point out that data-driven decision-making is a promising trend and the primary factor attributed to successful big data utilisation is the organisational alignment in every aspect in the companies. Entrepreneurs are encouraged to seize the great opportunities by making strategic adjustment within the organisation. Great transparency and accessibility of data is required, so as technological innovation becomes an essential element to support organisational decisions with sophisticated algorithms.

Organisation engagement in social media. Personal interactions over the social media become more frequent with greater demand. Firms tend to use social media as a platform to promote and deliver information to audiences. Dijkmans et al. (2015) demonstrate that corporates' online activities encourage consumers' social media use, which can enhance corporate reputation especially among non-customers. Miller and Tucker (2013) also find incremental engagement with social media of client and employees when organisations actively managing their social media presence. However, it is unclear how active firms should be in engaging with consumers through social media. Several studies start with exploring the effectiveness of managing social media on firm performance and customer satisfaction though participating online communication (Gu and Ye, 2014; van Noort and Willemsen, 2012; Vermeulen and Seegers, 2009).

4.1.3 Human resource management

This perspective on big data focuses on how human resources and performance can be improved or enhanced using big data. This includes performance evaluation, training and development, staff utilisation and skills formation (see Scullion and Linehan, 2005). As an organisational function, human resource management (HRM) has been examined within big data context from three aspects. The primary view is using social media to assist personnel decisions. For instance, in the frontline recruitment, more insights of the potential hires can be revealed through looking at social media profiles and online professional network. Besides, workforce data can be also adopted to assess employee performance, which can deliver more informed solutions to talent management, staff engagement and productivity enhancement. The use of social media in corporate HRM practice has been recognised by Roth et al. (2013) as of great importance for organisation, individual and society, which needs further research. Nonetheless, whether social media information of job applicants is critical in recruitment selection remains to be a question, as some research regards it as irrelevant and invalid (van Iddekinge et al., 2016).

Besides, as big data requires advanced data analytics skills, HRM is expected to function in a different way in talent management. Expertise in data management and analytics is in great need, and Tambe (2014) illustrates that labour with technical skills together with big data investment are necessary attributes to productivity growth and development, which leads to changes in strategic workforce planning. Moreover, leadership is expected to change with active engagement in developing strategic orientation and data-driven operation. According to Gerhardt et al. (2012), business leaders should engage in the entire big data ecosystem to earn more benefits from sharing information to the external of the organisation. Within organisational study, attention has been paid mostly to the adaptation of various functions in an institution to the data-driven environment and approach. To further develop the understanding in this area, more specific action plans are expected to guide the process of organisational alignment with big data in aspects of culture, management functions and operations.

Going beyond the conceptual roadmap, empirical evaluation of new approaches in HRM and other activities remains to be done in the future.

4.2 Operation Perspective of Big Data

From a business operation perspective, big data has been explored in a way to improve production and operation efficiency. In operation and production field, there are few studies and current research interests are mainly laid on the following topics (see Table 3).

Table 3. Operation Perspective of Big Data

Operational perspective		**Studies**
Operation management	Operation process	Aloysius et al.(2016); Chan et al.(2016); Guo et al.(2014); Huang and Van Mieghem(2014); Kumar et al.(2016); Li et al.(2015); Zhong et al.(2015)
	Production and innovation	Abrahams et al.(2015); Chan et al.(2016); Jin et al.(2016); Mount and Martinez(2014); Qi et al.(2016); Zhan et al.(2016)
	Operation research	Mortenson et al. (2015)
Supply chain management		Chae(2015); Chen et al.(2015); Groves et al.(2014); Hahn and Packowski(2015); Hazen et al.(2014); Hazen et al.(2016); Kache and Seuring(2017); Li and Wang(2015); Tan et al.(2015); Wang et al.(2016);

Operation management. Operation management (OM) deals with the design and control of the overall production and operation process to achieve high efficiency in resource planning and effectiveness in business goal accomplishment. With real-time data collected from smart devices, managers have access to unstructured data source, which is helpful in achieving better performance in understanding customers, managing risks, and reducing costs. Current researches have discussed the possibility to incorporate social media, web and sensor data in operation process and production. Chan et al. (2016) find out that social media comments can be analysed to discover useful information for OM, such as product defect discovery (Abrahams et al., 2015), and new product development (Chan et al., 2016).

Besides, Web data such as clickstream can be used to predict offline orders and reduce inventory cost (Huang and Van Mieghem, 2014). Introduced in Guo et al. (2014), cloud-based order tracking and allocation system can reduce production costs and improve efficiency. Moreover, big data promotes innovation in new ideas and methods to collet, store, analyse, adopt, and share it, and it has benefits to be applied for open innovation process (Mount and Martinez, 2014). Overall, efficiency is expected to improve by leveraging big data in business operations. Accordingly, operational research should interact more with big data analytics to take advantage of the comprehensive ecosystem.

Supply chain management. Big data analytics has proven its value in managing the flow of goods and services. Fuchs and Otto (2015) demonstrate the information technology in supply chain planning has significant values and improvement in supply chain can be obtained by financing the IT function. New analytics techniques are developed to support supply chain operations and innovation (Tan et al., 2015). There is potential growth of the in-memory analytics applications in supply chain management due to the real-time data availability and integrated processing models to support operations (Hahn and Packowski, 2015). Besides, sensor data can be used to improve food supply chain management and dynamic pricing (Li and Wang, 2015).

In addition, it is worth noting that data quality is very important in the research and practice in supply chain management, which requires interdisciplinary cooperation to develop control method (Hazen et al., 2014). Efficiency is the keyword in the operation aspect. It leads to greater utilisation of real time data to reduce costs and risks, as well as stimulate innovation. But to what extent the efficiency can be potentially enhanced with big data incorporated in the existing operation system remains unclear. This is a possible direction where more studies are expected to clarify its magnitude. In addition, the innovative aspect of big data in developing new ideas and new product needs further exploration.

4.3 Marketing Perspective of Big Data

In a broad sense, marketing is "the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large" (American Marketing Association, 2013, pp. nd)[1]. Efficient communications between firms and customers can promote selling of particular products, service and brand. Through this lens, understanding consumers is the core element in making marketing decisions. Here we survey literature focusing on interpretation of consumer behaviour and sentiment, and several topics are revealed (see Table 4).

4.3.1 Consumer behaviour

Consumer behaviour reflects the decision making process of customers in selecting, purchasing, utilising the product or service. It is a complicated process and affected by diversified factors. Previous big data researches try to understand consumer behaviour using big data (e.g. mobile, social media data) or considering online social network influence.

User behaviour. Under this topic, there are three aspects to view this issue. The first one links to mobile analytics, which examines the mobile Internet usage behaviour and user engagement. It has been discovered that geographical mobility of users and social network have positive influences on mobile Internet usage behaviour while multimedia content generation have negative influence (Ghose and Han, 2011). Besides, ranking effects (Ghose et al., 2013) and rewarding (Claussen et al., 2013) promote user engagement and mobile app success, which can increase corresponding mobile website visit (Xu et al., 2014). Second, purchase behaviour is affected by various factors, such as online social media brand community (Goh et al., 2013) and interactive social influences (Zhang et al., 2014). Thus concurrent learning of users' behaviour is beneficial to real-time, intent-based optimal interventions, which increases purchase likelihood (Ding et al., 2015). In addition, learning behaviour is also

[1] Retrieved from https://www.ama.org/AboutAMA/Pages/Definition-of-Marketing.aspx

investigated in prior studies using video stream, blogs and other data to detect the interaction and learning pattern.

Online community. The increasing interaction via the Internet brings out online community, which is a virtual community where members acquire information and communicate with each other through social network platform. Current studies focus on detecting online community as well as identifying characteristic within the community. Several papers propose methods to detect groups in virtual communities (Chau and Xu, 2007; Wang et al., 2013), discover information (Garg et al., 2011), and identify community (Ludwig et al., 2014). Furthermore, within the online community, leadership and identification emerge, especially the linguistic style match, which shape the community dynamics (Johnson et al., 2015) and drive the network growth (Lu et al., 2013).

Social network effect. Consumer behaviour is also influenced by social network, where the pattern and dynamics, and influencing entities may have great impact. Through analysing social network, adoption probability can be predicted (Fang et al., 2013). Besides, social media can enrich network information, which has positive effect on work productivity and job security (Wu, 2013), brand and retailer performance as well as consumer-retailer loyalty (Rapp et al., 2013). In particular, online user-generated content has positive relation with their social ties and its network effects can boost advertising and revenue growth (Shriver et al., 2013).

4.3.2 Consumer sentiment

Consumer sentiment reflects consumer's feelings, perception, and evaluation of product or service. In e-commerce, online review and rating systems have been designed to detect consumer's opinion and sentiment towards specific commodity (Dellarocas et al., 2007). Besides, sentiment analysis is a hot topic with advancement in analytics techniques and application. One point to note here is that studies on big data from the consumer perspective is not limited to marketing purposes. Looking into consumer opinions can also shed light on operation and production improvement.

Online review. Online review is a form of e-WOM communication and analysing the user-generated contents can potentially predict future sales and assist marketing strategy (Archak et al., 2011; Moon et al., 2014; Lee and Bradlow, 2011). As it has significant impact on consumers' choices, it is important to predict and improve the helpfulness of reviews. Several studies (e.g. Baek et al., 2012; Cao et al., 2011) investigate the influencing factors of review helpfulness and try to predict helpfulness by looking into text linguistic features or reviewer engagement characteristics (Krishnamoorthy, 2015; Ngo-Ye and Sinha, 2014). Furthermore, online reviews have social influence on other consumers (Sridhar and Srinivasan, 2012), such as their perception of reviews (Cheng and Ho, 2015) and way of writing reviews (Goes et al., 2014; Ludwig et al., 2013). It can also be utilised to measure customer satisfaction with greater effectiveness and efficiency (Kang and Park, 2014). In addition, to enable deeper analysis of product reviews, several advanced text-mining approaches are explored based on language, web or topic structure, which forms part of research in this topic.

Online rating. It normally takes a form of numerical rating where consumers evaluate the products or services by giving scores. The ranking systems analyse user-generated content to assess customer's preference hence provide best-fit product and service (Ghose et al., 2012). Indeed, Moe and Trusov (2011) illustrate that online product ratings dynamics have direct and immediate effects on sales. Sun (2012) further proves a higher variance of product ratings can help with sales increase only if the average rating is low. Besides, online ratings have social influence on other user's rating behaviour (Lee et al., 2015). Moreover, Hu et al. (2012) found that firm manipulation in product rating requires further attention from the business operators.

Sentiment analysis. Sentiment analysis extracts and classifies subjective information in various data sources, which can be applied to improve business intelligence. A synonym, opinion mining, often refers to the same field of study, and we use this term to categories general studies on this topic. Overall, opinion mining provides useful information for decision-making (Alfaro et al., 2013). Especially the marketplace sentiment can advance the way of understanding consumers which is

beneficial to niche market identification (Gopaldas, 2014; Jang et al., 2013; He et al., 2015) and brand positioning (Mostafa et al., 2013). Web comment text, social media (e.g. microblog), product reviews and other user-generated contents are commonly used in these studies. In addition, sentiment detection and classification as part of sentiment analysis also attracts research interests. Based on practical purposes, a lot of new methods are explored to detect emotions (e.g. Balahur et al., 2012; Gao et al., 2015), spot topics (e.g. Li and Wu, 2010), and improve sentiment classification accuracy (e.g. Colace et al., 2015; Khan et la., 2014; Da Silva et al., 2014). They are broadly applied to analyse sentiment and opinions of consumers and market, so as to enhance the overall management efficiency.

4.3.3 Marketing strategy

Big customer data facilitates more specialised market segmentation, which advances marketing strategies such as personalised advertising, brand improvement, and recommendation. Besides, the predictive analytics can examine the real-time marketing performance and influential factors, which enables dynamic adjustment of advertisement strategy (Nichols, 2013).

Advertising and targeting. Advertising is a form of marketing strategy aiming for promoting and selling the product or service, and targeting as a type of advertising segments consumers and communicates with them based on specific behavioural, demographics, psychographics and other features. In recent research, mobile targeting and advertising has been proved to be effective for location-based services (Li and Du, 2012). By incorporating locational and geographical parameters, retailers have more power in offering discriminated prices (Fong et al., 2015) and increase sales (Luo et al., 2014). Andrews et al. (2015) illustrates that physical crowdedness has positive impacts on consumers' response to mobile ads, which is beneficial to hyper-contextual mobile advertisement. Nonetheless, social effects on advertising may vary across markets with different demographic characteristics and groups (Gopinath et al., 2013).

Brand analysis. In general, brand analysis pins down brand position in market, brand perception by consumers, and competitors' brand performance, and so on forth. Regarding big data brand analysis, investigations are most done in a social and consumer context. For example, social media strategic capability can enhance brand innovation (Nguyen et al., 2015) and social tagging has great implications for brand performance measurement and brand equity management (Nam and Kannan, 2014). Besides, online information has an influence on consumers' perception of brands and Camiciottoli et al. (2014) find consistent brand associations in online community of international consumers. Moreover, dynamic analysis of online user-generated content can reflect consumer satisfaction with quality thus improve competitive brand positions (Tirunillai and Tellis, 2014). But, it is worth noticing that analysis of brand sentiment cannot ignore the differences across different social media venue formats (Schweidel and Moe, 2014).

Market analysis. The review indicates that there are several directions in leveraging big data in market analysis. One is market prediction by mining textual and web information from company websites (Nassirtoussi et al., 2014; Nassirtoussi et al., 2015). It has been proven that such information is useful to predict commercial success (Thorleuchter and van den Poel, 2012). A second area is using user-generated contents to enhance marketing efficiency. It can be applied to improve mapping of market structure (Netzer et al., 2012), detect customer-website interaction (Schäfer and Kummer, 2013), and identify future profitable customers more accurately (D'Haen et al., 2013; Thorleuchter et al., 2012). Especially in the era of e-commerce, via capturing detailed customer behaviour information, the knowledge management strategy in marketing can help companies gain competitive advantages in business activities through establishing better interpersonal relations to customers, suppliers, business partners and employees. Digital data plays an increasing important role in B2C and B2B marketing, but there are also challenges facing companies that need to be further addressed (Leeflang et al., 2014).

Recommendation and e-WOM. In Web 2.0 era, recommendation is becoming more customised. User-generated content and their sentiment are analysed to improve accommodating customer needs

(Colace et al, 2015; García-Cumbreras et al., 2013; Hyung et al., 2014). Personalised recommendation is achievable with technology improvement and big customer data (Rust and Huang, 2014). According to the findings in Brown et al. (2011), more advanced analysis and customisation are attainable with the use of real-time and wide ranging data streams. Through routing location (Yang et al., 2008), social network (Chung et al., 2015), community (Feng et al., 2015), and personalised information (Fan et al., 2006), user preference and behaviour can be detected and predicted, which promotes personalisation in marketing entering a higher level. Another powerful tool in recommendation is word-of-mouth, which is an effective form of advertising. In a digital world, online communications and interactions are more frequent. Such electronic word-of-mouth (e-WOM) has expanded impact through Internet on consumer perception and purchase decisions. Many studies have addressed the e-WOM and its impact on sales and consumer behaviour (see Table 4).

From the marketing lens, customer is the priority and understanding their behaviour is the primary concern for marketing researchers. However, information overload may also lead to adverse effects to marketing and firm performance, which has not been well considered in current literature. Besides, the marketing practice should be integrated into higher strategic framework to guide more efficient segmenting and pricing, and this leave research spaces for revenue management and strategic management. In addition, it is understudied in prior studies that what roles the firms play in the digital marketing campaign and their engagement in the online communication activities is an interesting area to be explored in future.

Table 4. Marketing Perspective of Big Data

Marketing perspective			Studies
Consumer behaviour	User behaviour	Customer engagement	Amaro et al.(2016); Claussen et al.(2013); Ding et al.(2015); Ghose and Han(2011); Ghose et al.(2013); Guesalaga(2016); Han et al.(2016); Harrigan et al.(2017); Oh et al.(2017); Pagani and Malacarne(2017); Risius and Beck(2015); van Doorn et al.(2010); VanMeter et al.(2015); Xu et al.(2014)
		Online learning	He(2013); Mayzlin and Yoganarasimhan(2012); Singh et al.(2014)
	Online community	Online community detection	Chau and Xu(2007); Garg et al.(2011); Ludwig et al.(2014); Wang et al.(2013)
		Online community leadership	Johnson et al.(2015); Lu et al.(2013)
	Social network effect		Fang et al.(2013); Goh et al.(2013); Rapp et al.(2013); Shen et al. (2016); Shriver et al.(2013); Wu(2013); Zhang et al.(2014)
Consumer sentiment	Online review	Marketing and sale prediction	Archak et al.(2011); Chong et al.(2016); Lee and Bradlow(2011); Mauri and Minazzi(2013); Moon et al.(2014); Salehan and Kim(2016); Schneider and Gupta(2016); Sparks and Browning (2011); Xie et al.(2017); Ye et al.(2009); Zhu and Zhang(2010)
		Review helpfulness	Baek et al.(2012); Cao et al.(2011); Chen and Tseng(2011); Krishnamoorthy(2015); Ngo-Ye and Sinha(2014); Singh et al.(2017)
		Social influence	Cheng and Ho(2015); Goes et al.(2014); Ludwig et al.(2013); Sridhar and Srinivasan(2012)
		Customer satisfaction	Chen et al.(2016); Hildebrand et al.(2013); Kang and Park(2014); Xiang et al.(2015)
		Text mining	Ordenes et al. (2014); Wang et al.(2013); Zhan et al.(2009)
	Rating and ranking		Büschken and Allenby(2016); Chung and Tseng(2012); Gao et al.(2015); Ghose et al.(2012); Lee et al.(2015); Moe and Trusov(2011); Sun(2012)
	Sentiment analysis	Opinion mining	Alfaro et al.(2013); García-Moya et al.(2013); Gopaldas(2014); He et al.(2015); Homburg et al.(2015); Jang et al.(2013); Kontopoulos et al.(2013); Li and Wu(2010); Marrese-Taylor et al.(2014)
		Sentiment detection	Balahur et al.(2012); Colace et al.(2015); Costa et al.(2012); Das and Chen(2007); Dehkharghani et al.(2014); Gao et al.(2015); Mostafa et al.(2013); Yang and Lee(2008)
		Sentiment classification	Da Silva et al.(2014); Deng et al.(2014); Fang et al.(2014); Fersini et al.(2014); Khan et al.(2014); Ye et al.(2009)
Marketing strategy	Advertising and targeting	Mobile advertising and targeting	Andrews et al.(2015); Fong et al.(2015); Ghose and Han(2014); Grewal et al.(2016); Li and Du(2012); Luo et al.(2014); Shankar et al.(2016)

		Digital and social media advertising	Ghose and Todri-Adamopoulos(2016); Gopinath et al.(2013); Iyer and Katona(2015); Järvinen and Karjaluoto(2015); Kumar et al.(2017); Li et al. (2014); Liu and Mattila(2017); Malthouse et al.(2013); Mariani et al.(2016); Trusov et al.(2016)
	Brand analysis		Camiciottoli et al.(2014); Culotta and Cutler(2016); Godey et al.(2016); Gretry et al.(2017); Hamilton et al.(2016); Költringer and Dickinger(2015); Moro et al.(2016); Nam and Kannan(2014); Nguyen et al.(2015); Pournarakis et al.(2017); Schweidel and Moe(2014); Tirunillai and Tellis(2014);
	Electronic word-of-mouth		Balaji et al.(2016); Cantallops and Salvi(2014); Cascio et al.(2015); Chen and Xie (2005); Eisingerich et al.(2015); Hennig-Thurau et al.(2015); Kim et al.(2015); King et al.(2014); Kumar et al.(2016); Lee and Song(2010); Mayzlin (2006); Godes and Mayzlin(2009); Sonnier et al.(2011); Tang and Guo(2015); Xiang et al.(2017)
	Market analysis	Market prediction	Beukeboom et al.(2015); D'Haen et al.(2013); France and Ghose(2016); Liu et al.(2016); Nassirtoussi et al.(2014); Nassirtoussi et al.(2015); Netzer et al.(2012); Thorleuchter et al.(2012);
		E-commerce	Leeflang et al.(2014); Oestreicher-Singer and Sundararajan(2012); Schäfer and Kummer(2013); Thorleuchter and Van den Poel(2012)
	Recommendation	Recommendation	Colace et al.(2015); García-Cumbreras et al.(2013); Hyung et al.(2014); Zhang and Jiao(2007)
		Personalisation	Chung et al.(2015); Fan et al. (2006); Feng et al.(2015); Ho et al.(2011); Lee(2007); Rust and Huang(2014); Yang et al.(2008); Yeh et al.(2009)

4.4 Information Management Perspective of Big Data

From the information management perspective, big data research primarily concerns data acquisition and process effectiveness. The availability and feasibility of information is critical to organisational success in term of strategic decision-making. It closely relates to data and technology issues, and there are diversified papers on big data management and analytics problems, especially in technology and engineering fields. Nevertheless, this paper limits the view to management-related or business-related articles. These papers propose or adopt improved or novel approaches to deal with big data for various management purposes. In general, information management professionals and researchers are particularly interested in acquiring information and knowledge from various data sources (see Table 5).

Table 5 Information Management Perspective of Big Data

Information management perspective	Studies
Information retrieval	Beebe et al.(2011) ; Dai et al.(2015); Liao et al.(2014); Wei et al.(2007)
Knowledge discovery	Chung et al. (2005); Lee and Wang(2012); Lee et al.(2011); Li et al.(2016); Zhou et al.(2016)
Text mining	Duan et al.(2011) ; Hashimi et al.(2015); Lo(2008); Singh et al.(2011); Yang(2009)
Web mining	Chau and Chen(2008); Prates et al.(2013); Wang et al.(2007)
Idea mining	Thorleuchter and Van den Poel(2013); Thorleuchter et al.(2010)
Topic detection	Bao and Datta(2014); Özyurt and Köse(2010); Yoon(2012); Zeng et al.(2010)
Document clustering	Kou and Lou(2012); Wei et al. (2006); Wei et al.(2008); Wei et al.(2008)
Document classification	Colace et al.(2014); Ur-Rahman and Harding(2012)
Cloud computing	Demirkan and Delen(2013); Marston et al.(2011)

Information retrieval frameworks are advanced with better search effectiveness (Liao et al, 2014; Beebe et al., 2011; Wei et al., 2007), so as knowledge discovery in web searching and geographic information retrieval (Lee and Wang, 2012; Lee et al., 2011). Textual and web data attract most interests in current research and many studies address text mining (e.g. Duan et al., 2011; Hashimi et al., 2015) and web mining (Chau and Chen, 2008; Wang et al., 2007) problems for the purpose of

improving information search and extraction efficiency. Moreover, clustering and classification of data is critical to data management and subsequent data analysis. Novel and improved approaches have been put forward in an attempt to achieve better effectiveness and accuracy (e.g. Wei et al., 2008; Ur-Rahman and Harding, 2012). These advanced methods facilitate topic detection for business planning and risk control (e.g. Zeng et al., 2010; Yoon, 2012; Bao and Datta, 2014), as well as idea mining for innovation (e.g. Thorleuchter and Van den Poel., 2013; Thorleuchter et al., 2010). Overall, big data research in information management explores new ways to deal with massive data and these methods can be applied to studies in different areas, which provide solid technical or technological support for research in other management fields.

4.5 Other Perspective of Big Data

Apart from the above main streams in current big data literature, some researchers look into big data in management and business from several other different perspectives (see Table 6).

Table 6. Other Management Perspectives of Big Data

Other perspectives		**Studies**
Accounting and Finance	Financial performance	Balakrishnan et al.(2010); Schniederjans et al.(2013); Seddon and Currie(2017); Yu et al.(2013)
	Accounting and auditing	Brown-Liburd et al.(2015); Cao et al.(2015); Glancy and Yadav(2011); Vasarhelyi et al.(2015)
International business		Lau et al.(2012); Okazaki and Taylor(2013)
Public administration		Grimmelikhuijsen and Meijer(2015); Guillamón et al.(2016); Huberty(2015); Jun and Chung(2016); Lavertu (2015); Lev-On and Steinfeld(2015); Panagiotopoulos et al.(2016); Suh et al.(2010); Wang and Hajli(2017); Welch et al.(2016); Wu et al.(2016); Zissis and Lekkas(2011)
Others		Chang et al.(2014); Coussement and Van den Poel(2008); Fuller et al.(2011); Noh et al.(2015)

Accounting and Finance. In accounting and finance area, big data is regarded as an informative source that can affect and predict firm financial performance (Balakrishnan et al., 2010). Especially social media has great effects on stock performance (Schniederjans et al., 2013; Yu et al., 2013). Besides, by incorporating big data, accounting nature and audit judgement are also changing (Vasarhelyi et al., 2015; Brown-Liburd et al., 2015). Textual data is effectively used to detect financial fraud in reports (Glancy and Yadav, 2011) and Cao et al. (2015) discuss the potential adoption of big data analytics to improve financial statement audits efficiency.

International business. The international business perspective refers to the big data driven studies on performance of trade and investment activities by firms across national borders (see Cavusgil et al., 2012). Articles are rarely seen in this area in present research. In the Web 2.0 environment, big data is expected to play a role in global business. As illustrated in Lau et al. (2012), online environment scanning using Web 2.0 helps improve decision making on cross-border merger and acquisition. Okazaki and Taylor (2013) focus on use of social media for international advertising and identify several theoretical foundations for future search. There remains research space around this topic to explore the potential use of big data in international business decisions and operations.

Public administration. In public service, big data has several application areas. One recent study has focused on how big data could be utilised in combating health emergences such as Ebola (Amankwah-Amoah, 2016). Furthermore, e-voting and e-government can benefit from big data, such as cloud computing (Zissis and Lekkas, 2011). Likewise, Suh et al. (2010) discovered that text could be combined with data mining to efficiently detect and forecast trend of petition in e-government. Because of greater transparency and participation, use of social media can enhance perceived police legitimacy (Grimmelikhuijsen and Meijer, 2015) and big data may assist improving the management of public programs (Lavertu, 2015).

5. DISCUSSIONS AND CONCLUSIONS

The paper sought to review the literature on big data across the social science disciplines. The study provided an overview of the big data research in management domain and presented insights from 284 articles. By classifying and analysing the identified literature, we clarify several perspectives of management communities in big data research, and suggest a road map for discovering potential research directions. To the best of our knowledge, this is the first comprehensive review on big data literature across the social science disciplines. There is growing body of research across the disciplines to demonstrate that the great potential of data-driven approach does not only sparkle at technical stage to extract and process information, but also the technological innovation promotes changes in managing organisation, operation, marketing and other business activities. By leveraging big data into management mechanism, additional values can be discovered, created and realised in business development. The foregoing analysis indicates that prior studies have identified big data's significance in business and management improvement. This review offers a clearer picture of the status of big data research and uncovered several viable directions for future academic work.

The organising framework reveals great needs and space for big data research in management domain. The preceding analysis indicates that despite the fact that management professionals and researchers have growing attention on big data, advancing technology and changing business environment mean that the full benefits have not been accrued yet. Therefore, there are potential benefits for management enhancement and business improvement. The implications of the findings are summarised in Table 7. First, the study indicates that, to discover the full value, firms need to formulate and implement a data-driven strategy. Top management teams should also make strategic adjustment within organisations through measure such as investment in IT innovation and data analytics skills development. Supported by advanced techniques to analyse and interpret big data, executives would be able to make decisions in a strategic, timely, and flexible manner. The overall performance of operation, marketing, and other business activities principally depend on the quality of strategic

decision-making, which also determines the realisation of profits and gaining of competitive advantages. It is a unified and dynamic cycle (see Figure 4), where all management activities are connected, and progress in each management area can contribute to the big data value achievement.

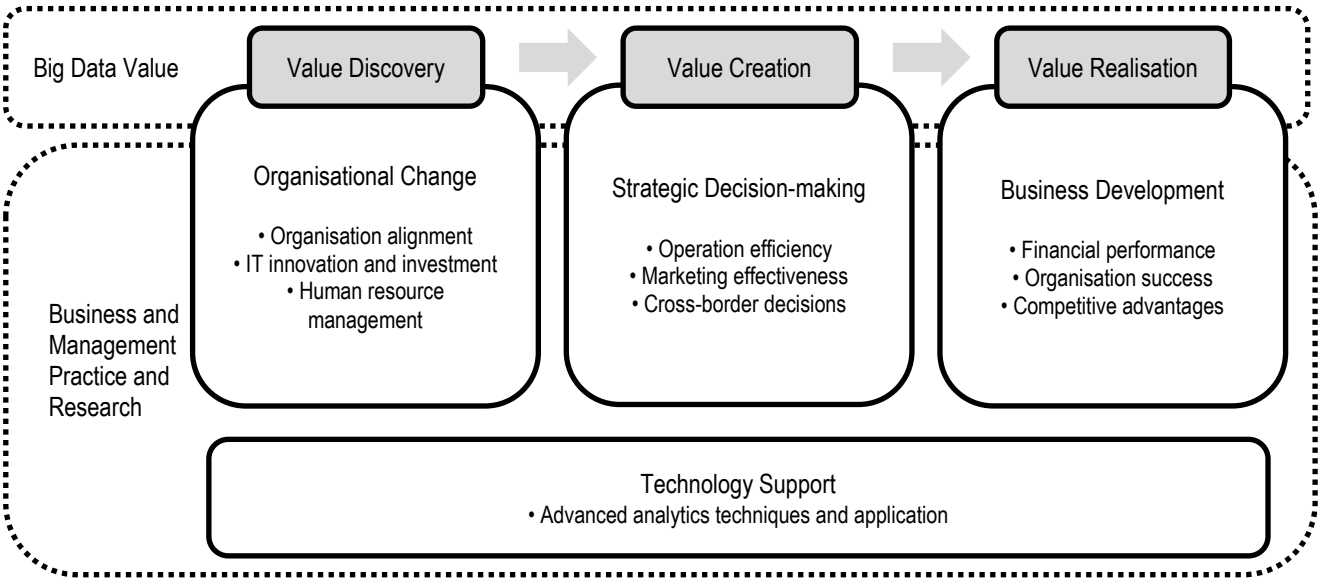


Figure 4. Big Data Value Achievement and Management Practice

It is also worth noting that "technology transfer" is critical for researchers to identify the best use of analytics techniques to achieve optimal performance. It is not clear in current research what techniques are available and optimal for data analytics in management. This needs to be clarified and comparatively evaluated. Another possible question relates to organisational investment in IT innovation, and its impacts. Besides, theoretical development is in a need to provide a general guidance for researchers to implement big data methods. Current studies have not depicted a roadmap or framework, and it remains unclear what theories or models have been derived to assist data-driven analysis. A logical next step is to examine techniques in use and their effectiveness. Current research interests among different topics are not evenly distributed, and some fruitful areas remain unstudied or insufficient. Based on the comprehensive review, a conceptual map of big data research is provided with central themes along the different management subjects (see Table 7). In all these subjective areas, some challenging and promising avenues are suggested for future research. Overall, our review provides a valuable and consolidation of extant big data research and can help strengthen management

and business research in this field. We are confident that our review provides valuable contributions to this evolving and important research field. We also hope it will serve as a platform for future research efforts in this area.

Table 7. Comparison of Perspectives of the Academic Communities in Big Data Research

Perspective	Key interest	Big data impact	Research context	Avenue for future research
Organisation	• Organisational change and strategic decision-making	• Data-driven decision • Ecosystem change • Management process • Innovation	• Organisation structure • Organisation functions • Big data commitment • Business intelligence • Strategic action	• Organisation alignment with data-driven strategy (e.g. culture, operation, function, etc.) • HRM improvement (e.g. talent management, leadership, skill training etc.) • Reshape of strategic operational mechanism and actions • New perceptions on value of experience, nature of expertise, practice of management
Operation	• Operation efficiency	• Real-time control • Reduced cost and risk	• Production, innovation and supply chain • Sensor/Web/Social media	• Innovation e.g. new product and operation process • Further improvement of operation efficiency • Big data supply chain evaluation
Marketing	• Consumer and marketing effectiveness	• Online evaluation • Personalisation • Better understanding of consumers and market	• Social media/Sensor • Advertising • Social influence • Consumer behaviour and sentiment	• Possible adverse effect of online social network marketing • Segmented pricing and revenue management • Firm engagement with online communication • New strategy evaluation
Information management	• Advanced analytics technique application	• Challenges in data management and analysis • Advanced algorithms	• Data acquisition and process • Modelling	• Models and techniques evaluation and comparison • Data quality improvement
Others	• Accounting and finance, Public sector, International business	• Firm performance • Greater transparency and participation • Better understanding of foreign market	• Social media • Management actions • Cross-border decision and operation	• Accounting quality • Challenges and risks of big data use in public sector • International decision and business operation (marketing, supply chain, merger and acquisition, investment etc.)

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