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How can organizations leverage big data to innovate their business models? A systematic literature review

Chiara Acciarini [a,b,*], Francesco Cappa [c], Paolo Boccardelli [d], Raffaele Oriani [d]

[a] La Sapienza University, Department of Computer, Control, and Management Engineering "Antonio Ruberti", Sapienza University of Rome, Via Ariosto 25 - 00185, Rome, Italy
[b] Luiss University, Viale Pola 12, 00198, Rome, Italy
[c] Campus Bio-medico University, Department of Engineering, Via Alvaro del Portillo 200, 00128, Rome, Italy
[d] Luiss University, Luiss Business School, Viale Pola 12, 00198, Rome, Italy

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ABSTRACT

The use of big data has garnered increasing importance in academic research and managerial practice thanks to the benefits it can produce in terms of innovation. However, big data also has drawbacks that have been overlooked so far. Therefore, to ensure the benefits outweigh the costs of big data, and to unlock the full potential of big data in terms of business model innovation, we argue that companies need to have a clear map of all its possible uses. With this aim in mind, we have summarized the current state of scholarship, outlined the uses of big data across different business areas in private and public organizations, and the types of methodologies adopted, and we have suggested future research avenues, building upon our systematic literature review of 311 articles indexed in the Scopus database. In this manner, we contribute to increasing our scientific understanding of the big data phenomenon, and we provide theoretical and practical advice on the possible uses of big data that may allow companies to innovate their business models.

1. Introduction

In 2017, The Economist stated that "The world's most valuable resource is no longer oil, but data" (The Economist, 2017). At present, the big data market is worth more than 55 billion dollars of revenues and it is expected to grow to 103 billion dollars by 2027 (Statista, 2022). Indeed, in recent years, we have witnessed an explosive increase in the amount of information available and managers and policymakers have increasingly recognized the benefits spawning from big data. However, drawbacks connected to big data, like privacy and security issues, are also emerging.

The extant literature has mainly dealt with the benefits that big data can provide, which include, for example, more sustainable operations and supply chain management ((Etzion and Aragon-Correa, 2016), better budgeting and marketing decision (Cappa et al., 2021; Chen et al., 2012; Gandomi and Haider, 2015; Wamba et al., 2017), and higher innovation (Erevelles et al., 2016). However, it is still the case that few authors have explored the dark side of big data (Cappa et al., 2021, 2022; Ghasemaghaei and Turel, 2020). For instance, big data implies costs for database creation, management, and analysis (Cappa et al., 2021), security issues (Ghasemaghaei, 2020), and reductions in decision quality due to the abundance of data (Ghasemaghaei and Turel, 2020; Janssen et al., 2017). A clear understanding of the benefits and costs of big data will allow organizations to ensure the former outweigh the latter. To contribute in this direction, a review of studies conducted so far in this context may be crucial to understanding the effects big data can have when innovating.

The majority of past reviews focused on the application of big data to specific domains like supply chains, logistics ((Bălan, 2018); (Lamba and Singh, 2019), and production ((Kristoffersen et al., 2020); (Gupta et al., 2020), but they still overlooked the potential management and other applications in various business areas. In addition, while the review by (Wiener et al., 2020) summarized big data business model types, dimensions, and deployment, the focus of our study is different. In fact, we categorize the use of big data according to specific contexts (private vs public), business areas, and effects (positive vs negative); then, for each category identified, we assess the impact big data has in terms of business model innovation (BMI). To do this, we build on (Sorescu, 2017) in the identification of three building blocks (i.e., value creation, value capture, and value delivery). Therefore, our review adds to scientific

* Corresponding author. Via Ariosto, 25, 00185, Roma RM, Italy.
E-mail addresses: cacciarini@luiss.it, chiara.acciarini@uniroma1.it (C. Acciarini).

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knowledge of these recent phenomena by providing a comprehensive understanding of the impact that big data has on BMI.

We argue that companies need to have a clear map of the whole range of possible applications of big data if they wish to uncover their specific potential in different business areas. In this way, companies can identify potential interrelations across business areas and can interpret big data as a "valuable resource" (Cappa et al., 2021) to innovate their business models (BMs). In fact, big data can encourage the development of innovative products and services (Minatogawa et al., 2019). In addition, the importance of data on markets and customers can support organizations' decision-making and therefore their opportunities to create, capture, and deliver value (Sorescu, 2017). Furthermore, the emergence of innovative business models can be enabled by using big data that encourages new partnerships, new customer experiences, and new decisions. Consequently, we have carried out a systematic literature review to answer the following research question: *How can organizations innovate their business models by leveraging value from big data?* Specifically, i) we provide a big picture overview of the effects of big data applications in the contexts of public and private organizations, ii) we discuss the ways in which these companies collect, manage, and interpret large amounts of information across multiple business areas, and we iii) present different types of methodologies adopted in the field.

By drawing on big data and BMI theories, we fundamentally advance scientific knowledge regarding big data with an understanding of how companies can benefit from it. Our systematic literature review thus constitutes "the beginning of new journeys" (Massaro et al., 2016) on big data applications for innovation, presenting their potential within and across multiple business areas for companies today and in the near future. Thus, we map out the state of scholarship on big data and business model innovation, we delineate promising research avenues regarding big data and BMI, and we provide indications on how organizations can create, capture, and deliver value from big data by innovating their business model.

The remainder of the paper is as follows: in the preliminary section, we introduce the phenomenon of analysis providing a clear definition of big data. Subsequently, we discuss BMI to understand how companies need to leverage data to create, appropriate and deliver value. In the third section, we present the systematic literature review methodology applied in this study. Then, in section four, we present the results of our analysis by highlighting the most relevant insights. In the fifth section, we discuss the findings and report our contributions for theory and practice, and our considerations for future research directions. In the final section, we draw conclusions from our study.

2. Background

2.1. The big data phenomenon

The concept of "big data" that we currently have appeared for the first time in a National Aeronautics and Space Administration (NASA) Report in 1997 to stress the problems that they were facing in storing large amounts of information: "*Datasets are generally quite large, taxing capacities of main memory, local disk, and even remote disk. We call this the problem of big data.*" Thanks to increasing digitalization and to the emergence of new advanced technologies, the big data phenomenon has attracted even more attention in recent years (Ardito et al., 2019; Bohnsack et al., 2019; Cappa et al., 2021; Elia et al., 2020; Hanelt et al., 2021; Visconti and Morea, 2019). At present, the annual volume of data and information created worldwide amounts to around 64.5 zettabytes and it is expected to grow to 175 zettabytes in 2025 (Statista, 2020). Big data has the potential to be collected and used by different types of organizations, processed through specific capabilities like big data analytics (BDA) (Akter and Wamba, 2016; Aryal et al., 2018; Erevelles et al., 2016) and advanced technologies like artificial intelligence and machine learning (Zhou et al., 2017).

However, the concept of big data is not only related to massive volumes of information; in fact, various dimensions of big data are also equally important and have been presented in previous studies. For instance, (Hofmann, 2017; Jin et al., 2015; Johnson et al., 2017; Wamba et al., 2015; Wang et al., 2016) referred to *three* dimensions called velocity, volume, and variety. Big data *volume* is defined as "a firm's ability to successfully process large amounts of data" (Hofmann, 2017), while *velocity* is characterized by speed in successfully generating and processing data (Hofmann, 2017; L'Heureux et al., 2017). Furthermore, big data *variety* denotes complexity in terms of dimensionality, relationships, and many other complications (Hong et al., 2018). (L'Heureux et al., 2017; Zikopoulos, 2012) added the *fourth* dimension, namely veracity, which refers to the degree of big data uncertainty in the content of user-generated data (Bendler et al., 2014; Liu, 2014). Authors like (Cappa et al., 2021; Gandomi and Haider, 2015; Gholizadeh et al., 2020; Jin et al., 2015; I. Lee, 2017) have included the *fifth* dimension of big data, i.e. value, leading to the established framework of 5Vs, which allows firms to increase their revenue and customer satisfaction, and to decrease operational costs (I. Lee, 2017). Therefore, big data can be considered a profitable source of information (Ianni et al., 2021).

2.2. Benefits and costs related to big data

The existing evidence on big data adoption is predominantly focused on the benefits produced (Berthon et al., 2015; Huang et al., 2020). To accurately understand the positive consequences of big data, it is suggested to align their implementation with the challenges posed by the specificities of the business (Akter and Wamba, 2016). In particular, (Sorescu, 2017) argued that the value of big data can be generated from particular resources and processes (value creation) and from products and services made (value delivery), or it can be associated with the cost and revenue functions (value appropriation). (Björkdahl and Holmén, 2019) also emphasized the value created by and captured from big data. Other authors (Akter et al., 2016) provided evidence that three components of BDA – namely connectivity, compatibility, and modularity – strongly influence the performance of firms. Furthermore, BDA enable the detection of vulnerabilities to increase resilience (Sarker et al., 2020) and the opportunity to offer personalized products and services (Mazzei and Noble, 2017).

With regard to the specificity of the business areas in which big data is used, (Amado et al., 2018) found an impact on activities like customer retention and customer segmentation in the field of marketing. Furthermore, in the area of finance, the availability of big data on large firms reduces problems with asymmetric information (Begenau et al., 2018). In addition, big data can enhance aggregate forecasts since it can be managed to monitor customer behavior as well as to assess traffic for Point-of-Sale (POS) systems (Boone et al., 2019). More generally, big data can lead to the discovery of new business opportunities (LaValle et al., 2010). For instance, thanks to the use of big data, Netflix has recently increased its customer retention rate (around 93%); in particular, this digital streaming platform implemented specific data analytics models to discover user behavior and buying patterns (Kapoor, 2021). In the hospitality sector, the Starwood hotel chain leveraged big data to establish a dynamic pricing strategy based on different factors such as the local and global economic situation, weather, and reservation behaviors (Mai, 2016).

While scientific and managerial attention towards big data has mainly related to the benefits it can generate, recently it has started becoming clear that there are also a number of drawbacks to be considered (Cappa et al., 2021). For instance, possible threats can derive from information breaches that produce data protection issues and risks for privacy and reputational damages (Trabucchi et al., 2017). Therefore companies need to carefully consider privacy issues to avoid threats deriving from the datafication of personal information (Mai, 2016), as data breaches can be extremely costly for organizations. In addition, there are problems associated with information overload (O'Reilly, 1980; van Knippenberg et al., 2015), which may lead to "infobesity." In

fact, companies need to be careful about an accurate selection of information within wide sets of available data. Although the potentially higher costs linked to big data volumes have been discussed in recent studies (Cappa et al., 2021; Foss and Saebi, 2017), which emphasized the negative effects linked to data storage, analysis, and management, as well as privacy and reputation risks, the drawbacks associated with big data have mainly been overlooked so far.

2.3. Business model, business model innovation and big data

A BM has been defined as a conceptual instrument that is useful to describe aspects like product innovation, infrastructure management, and customer connections (Osterwalder et al., 2010). In the study by (Osterwalder et al., 2010), BMs are described and assessed according to the following building blocks: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. Moreover, a BM has been described as a tool for showing how value is created for stakeholders (Applegate, 2001).

Companies need to continuously renew their BMs, and so a crucial aspect is understanding what can facilitate innovation, i.e., BMI. For instance, the study by (Massa and Tucci, 2014) defined BMI as "an important *vehicle* for innovation" (Massa and Tucci, 2014) and claimed that the development of new technologies encourages the reconfiguration of existing BMs or the emergence of new ones (Osterwalder et al., 2010). When BMs are innovated, positive implications in terms of firm performance (Foss and Saebi, 2017; Hu, 2014; Zott and Amit, 2008), revenue growth, and profit margins (Amit and Zott, 2012) can be derived. In addition, in the rapidly expanding world of big data, new opportunities for doing innovative business and providing many benefits can derive from the aggregation, exchange, and reconstitution of information (Wang et al., 2016). In fact, this large amount of information can support firms in developing new ways to use data to meet their customers' needs, furnish them with additional products and services, and make better decisions.

As detailed in the following section, the systematic literature review we conducted aims to contribute to an understanding of the possible uses of big data in BMI that enable value creation, value capture, and value delivery for organizations.

3. Research methodology

The aim of our study is thus to systematically review the literature in the intersection between big data and BMI in order to map the different uses of big data in private and public organizations, and to provide promising insights on how companies can create, capture, and deliver value from the development of innovative and data-driven BMs. Towards this aim, we employed a systematic review approach that brings together extensive primary research papers, thus encouraging practitioners to inform their decisions with the evidence provided (Tranfield et al., 2003). We therefore offer a "descriptive analysis of the field" (Tranfield et al., 2003) by categorizing the various uses of big data in organizations.

Following Appio et al. (2014) and David and Han (2003), we employed a screening routine to identify the best search strategy. First, we identified on Scopus the field of "Business management, and accounting," to explore the effects of big data and BMI. To do this, we relied on (Sorescu, 2017) in the identification of the three building blocks (i.e., value creation, value capture, and value delivery) that can explain how to provide innovation in BMs. We therefore included the following terms in the query string: "business model," "innovation," "value creation," "value capture," and "value delivery," in association with "big data" (n = 3644). Second, after reading the abstracts of the papers resulting from this search, we derived additional keywords, i.e. "marketing," "sales," "customer service," "R&D," "supply chain," "forecasting," "engineering," "distribution," "production," "recruiting," "governance," "product development," "product management," "logistics" and "finance" to further detect the ways in which big data may help organizations to create, capture, and deliver value. Third, we validated the keywords identified by conducting a survey to gather managers' points of view. Specifically, via Qualtrics we contacted 150 former attendees of the full-time and part-time MBA courses that took place at a leading European business school in 2020. We asked open questions to explore whether and how big data is used within their organizations. The response rate was 84%, and the data collected from managers is summarized in Table 1. Then we conducted further validation of the business areas via scholars who published articles on big data-related topics. The resulting search of the Scopus database including all the above-mentioned keywords produced a total of 1630 studies.

Due to the recentness of the big data phenomenon, we focused on papers published in the 2014–2020 period, and this procedure yielded a sample of 714 studies. Moreover, based on the Academic Journal Guide 2018 ("ABS List"), we selected only papers published in journals rated 3, 4, and 4*.[1] We then excluded extant research that referred to big data in a general manner or as a marginal focus in their analyses, and we did not consider review articles. Including the above-mentioned journals, this final step led us to have 318 final articles. A team of four researchers separately determined whether each article should be excluded or included, they discussed the findings, and made the final decision. Ultimately, a total of 311 articles were selected. Table 2 summarizes the overall criteria and filters adopted for the final search and Fig. 1 illustrates our systematic literature review strategy.

The process of analysis considered the type of organization and the methodological approaches adopted, in addition to the specific

Table 1
List of the business areas identified in the literature and practice.

Classification from managers' survey[a]
Accounting/Finance (n = 9)
Customer relationship (n = 6)
Delivery/After sales (n = 2)
Engineering/Technical analysis (n = 4)
Forecasting/Planning (n = 1)
Governance/Regulation (n = 3)
R&D (i.e. Research and Development) (n = 26)
Logistics/Distribution/Procurement (n = 6)
Marketing/Pricing (n = 37)
Operations/Production (n = 17)
Product development and management (n = 4)
Recruiting (n = 2)
Sales (n = 9)
Supply chain (n = 1)

[a] n is the number of responses collected by each MBA part-time and full-time student. Some managers reported multiple business areas as their response.

[1] *Technological Forecasting And Social Change, International Journal Of Production Research, Industrial Marketing Management, Journal Of Business Research, International Journal Of Production Economics, Production And Operations Management, International Journal Of Forecasting, Tourism Management, Decision Support Systems, Production Planning And Control, Marketing Science, Information And Management, International Journal Of Operations And Production Management, Management Science, Transportation Research Part E Logistics And Transportation Review, Journal Of Marketing, IEEE Transactions On Engineering Management, International Journal Of Contemporary Hospitality Management, Journal Of Product Innovation Management, Journal Of Service Research, Information Society, International Journal Of Hospitality Management, International Journal Of Research In Marketing, International Journal Of Electronic Commerce, Journal Of Information Technology, Journal Of Supply Chain Management, Journal Of Travel Research, Public Administration Review, Journal Of The Academy Of Marketing Science, Technovation, British Journal Of Management, Business And Society, California Management Review, Decision Sciences, European Journal Of Marketing.*

Table 2
Criteria and filters adopted for the final search.

Criteria	Filters
Keywords	(("big data") AND ("business model" OR "innovation" OR "value creation" OR "value capture" OR "value delivery" OR "marketing" OR "sales" OR "customer service" OR "R&D" OR "research and development" OR "finance" OR "supply chain" OR "logistics" OR "forecasting" OR "engineering" OR "distribution" OR "production" OR "recruiting" OR "governance" OR "product development" OR "product management"))
Timespan	2014–2020
Document type	Journal articles
Publication stage	Final
Language	English
Subject areas	Business, management, and accounting
Source type	Only 3-4-4* Journals from the ABS List

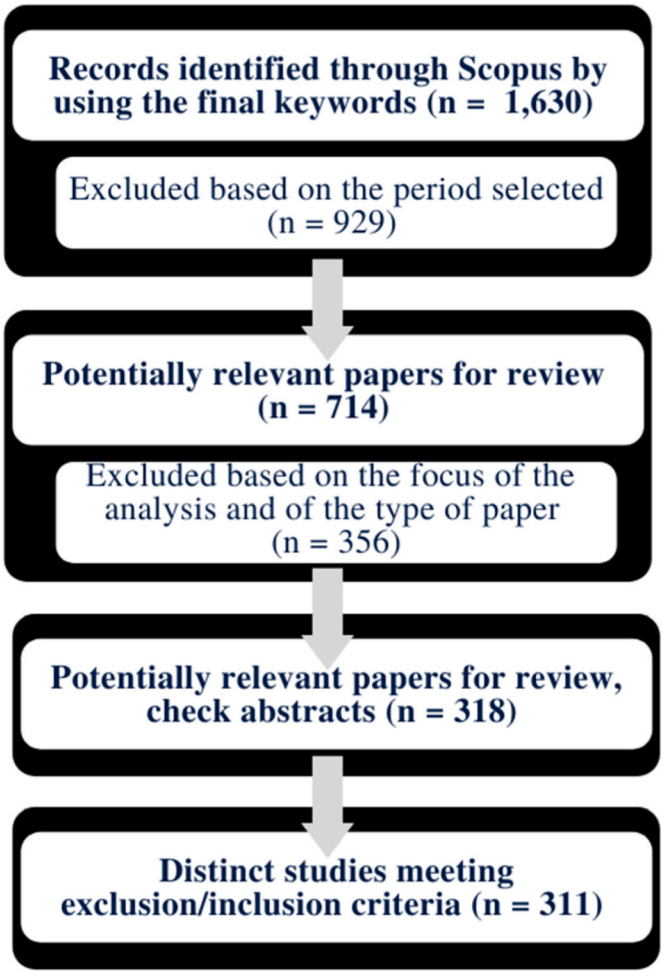

Fig. 1. Representation of the search strategy.

application of big data (Table 3). In relation to the type of organization, we mainly relied on the listed or non-listed criterion with the aim of defining whether an organization was publicly traded or private. We therefore checked whether the firms cited in each paper had shares listed on the stock exchange or not. Moreover, with regard to the specific use of big data, we distinguished whether big data was collected either internally or bought externally for each business area classified. This allowed us to delineate every use of big data explored so far, the potential effects, and promising future research avenues.

4. Findings

Based on general information in the retrieved articles, we summarized the effects of big data in the following categories: the *type of organization* (private or public), the *business area* in which the information is collected, managed, and interpreted, the *type of effect* produced by using big data, and the *research methodology* adopted. The categorization of these factors is presented in the sections below and is conducive to a better understanding of the use of big data across various organizations and business areas. Table 4 classifies the main effects of big data based on the methodology used and the business area in which big data is applied.

Many journals have contributed to the publication of the 167 articles on the use of big data in private organizations, which reveals how this topic is quite widespread in the extant literature. In this category, a total of 71 studies discussed how private organizations decided to acquire big data from external parties. Likewise, 157 studies have been published in relation to the use of big data in public organizations, with the majority of research studies (n = 88) being based on the internal collection of information. In general, big data multiple use cases prevail, in addition to the areas of supply chains and operations and production business. In addition, while the benefits associated with the use of big data in both private and public organizations have been widely discussed, the discourse around their drawbacks remains marginal.

4.1. Big data use in private organizations

The area of supply chains is the business area most frequently employed in big data research in the context of private organizations (Chehbi-Gamoura et al., 2020; Kache and Seuring, 2017; Li and Wang, 2017; Mukherjee and Sinha, 2018, 2018b; Öberg and Graham, 2016; Roβmann et al., 2018). While frequent benefits are associated with higher performance (Dubey et al., 2020; Trusov et al., 2016) and innovation (Arthur and Owen, 2019; Melander and Pazirandeh, 2019), the main challenges of big data are privacy-related (Cohen, 2018; Hopp et al., 2018).

4.1.1. Business areas considered and overall effect assessed in qualitative studies

The adoption of big data across multiple business areas has been studied extensively by conducting qualitative research (Gupta et al., 2019; Nunan and Di Domenico, 2017; Sorescu, 2017; Vitari and Raguseo, 2020). Positive effects are revealed in the context of financial services (Arthur and Owen, 2019) and in healthcare, where the interaction between ecosystems is enabled (Nguyen Dang Tuan et al., 2019). Thus, the ecosystem value creation process can be strengthened through mechanisms of collaboration and sharing activities; value capture opportunities can then be related to the appropriation of the total value created by the same ecosystem. Furthermore, the amount of information available increases the accuracy of forecasting for new products and communications with manufacturers (Nguyen Dang Tuan et al., 2019). (Gupta et al., 2019) investigated the potential to improve business operations through data-driven decision-making. Big data is associated with economic, ecological and social benefits when the stakeholders' network is strong (Gupta et al., 2019; Li et al., 2020). The multiple use of big data can also provide positive results in terms of customer knowledge, understanding of marketing trends, ability to meet demand faster (Mariani and Fosso Wamba, 2020), and new ways of engaging with customers (Zaki et al., 2019). In the era of Industry 4.0, data sharing promotes the establishment of supply chain platforms as well as the achievement of competitive advantage (Li et al., 2020). Therefore, the potential to create, capture, and deliver value can be achieved through the collection of detailed information about the market, and through the ability to interpret this information and use it to improve overall customer experience. In this manner, firms can map out their demand segments and provide customers with customized offerings.

Table 3
Classification of big data uses for private and public organizations, by source.

TYPE OF ORGANIZATION	BIG DATA SOURCE	BUSINESS AREA	AUTHORS
PRIVATE ORGANIZATIONS	*Bought externally*	Customer relationship	(Aloysius et al., 2016; Sivarajah et al., 2020; Chubin Zhang et al., 2020)
		Delivery and after sales	Ostrom et al. (2015)
		Forecasting and planning	(Boone et al., 2019; Lau et al., 2018; C. K. H. Lee, 2017; Yu et al., 2019)
		R&D	(El-Kassar and Singh, 2019; Farooqui et al., 2020; Ghasemaghaei and Calic, 2020; Lee, 2018)
		Logistics and procurement	Lamba and Singh (2019)
		Marketing and pricing	(Chong et al., 2016; Erevelles et al., 2016; Jabbar et al., 2020; Liu, 2020; Liu et al., 2016; Steinhoff et al., 2019; Wedel and Kannan, 2016)
		Operations and production	(Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019) (Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Feng and Shanthikumar, 2018; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Shukla and Tiwari, 2017; Troisi et al., 2020; Zaki et al., 2019)
		Product development and management	Jin et al. (2016)
		Recruiting	Mahmood and Mubarik (2020)
		Supply chains	(Aryal et al., 2018; Bansal et al., 2020; Baryannis et al., 2019; Brinch, 2018; Chehbi-Gamoura et al., 2020; Gawankar et al., 2020; Gunasekaran et al., 2017; Huang et al., 2018; Ivanov et al., 2019; Kache and Seuring, 2017; Li and Wang, 2017; Mukherjee and Sinha, 2018, 2018b; Öberg and Graham, 2016; Roβmann et al., 2018; Sanders, 2016)
		Multiple use cases	(Bălan, 2018; Chen, 2018; Corbett, 2018; Elia et al., 2020; Fisher and Raman, 2018; Foster et al., 2018; Martin, 2016; Melander and Pazirandeh, 2019; Mikalef et al., 2019, 2020; Nguyen Dang Tuan et al., 2019; Nunan and Di Domenico, 2017; Pigni et al., 2016; Raguseo and Vitari, 2018; Sestino et al., 2020; Sorescu, 2017; Vitari and Raguseo, 2020; Wang et al., 2016; Wiener et al., 2020)
		Sold to others	(Ghasemaghaei and Calic, 2020; Line et al., 2020; Wang et al., 2016; Wiener et al., 2020)
	Collected internally	Customer relationship	(Kitchens et al., 2018; Line et al., 2020; Zhang and Xiao, 2020)
		Delivery and after sales	(Huang et al., 2018; Opresnik and Taisch, 2015; Ostrom et al., 2015; Seitz et al., 2020)
		Engineering and technical analysis	(Chaoyang Zhang et al., 2020)
		Forecasting and planning	(Boone et al., 2019; Dubey et al., 2019c; Fang et al., 2020; Gunasekaran et al., 2017; Lau et al., 2018; Mariani and Fosso Wamba, 2020; Shen et al., 2019)
		Governance and regulation	(Mikalef et al., 2020; Shukla and Tiwari, 2017)
		R&D	(Arthur and Owen, 2019; El-Kassar and Singh, 2019; Ghasemaghaei and Calic, 2020; Lee, 2018)
		Logistics and procurement	(Lamba and Singh, 2019; Liu et al., 2020; Zhong et al., 2015, 2017)
		Marketing and pricing	(Dong and Yang, 2020; Erevelles et al., 2016; Jabbar et al., 2020; Martin, 2016; Sivarajah et al., 2020; Trusov et al., 2016; Wedel and Kannan, 2016; Xu et al., 2016; Yang et al., 2014, 2020)
		Operations and production	(Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Zaki et al., 2019)
		Product development and management	Johnson et al. (2017)
		Recruiting	Mahmood and Mubarik (2020)
		Sales	Hallikainen et al. (2020)
		Supply chain	(Aryal et al., 2018; Bansal et al., 2020; Baryannis et al., 2019; Brinch, 2018; Chehbi-Gamoura et al., 2020; Dubey et al., 2019c; Fosso Wamba and Akter, 2019; Gupta et al., 2019; Hofmann, 2017; Jha et al.,

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Table 3 (*continued*)

TYPE OF ORGANIZATION	BIG DATA SOURCE	BUSINESS AREA	AUTHORS
			2020; Kache and Seuring, 2017; Kamble et al., 2020; Kamble and Gunasekaran, 2020, 2020b; Öberg and Graham, 2016; Roβmann et al., 2018; Sanders, 2016)
		Multiple use cases	(Akter et al., 2020; Chen, 2018; Corbett, 2018; Dubey et al., 2020; Elia et al., 2020; Ghasemaghaei and Calic, 2019; Grover et al., 2018; Hopp et al., 2018; Ivanov et al., 2019; Jabbour et al., 2019; Kim and Lee, 2016; Kristoffersen et al., 2020; Li et al., 2020; Nguyen Dang Tuan et al., 2019; Nunan and Di Domenico, 2017; Pigni et al., 2016; Raguseo and Vitari, 2018; Sestino et al., 2020; Sheng et al., 2017; Sorescu, 2017; Vitari and Raguseo, 2020; Wamba et al., 2017; Wang et al., 2016; Wiener et al., 2020; Zhang et al., 2019)
		Sold to others	(Cohen, 2018; Ghasemaghaei and Calic, 2020; Gunasekaran et al., 2017; Huang et al., 2018; Lau et al., 2018; Line et al., 2020; Opresnik and Taisch, 2015; Wang et al., 2016; Wiener et al., 2020)
PUBLIC ORGANIZATION	*Bought externally*	Customer relationship	(Lee et al., 2019; Line et al., 2020; Sivarajah et al., 2020; Chubing Zhang et al., 2020)
		Delivery and after sales	Ostrom et al. (2015)
		Forecasting and planning	(Boone et al., 2019; Chong et al., 2017; Lau et al., 2018; Saito et al., 2016)
		Governance and regulation	(Flyverbom et al., 2017; Julsrud and Krogstad, 2020; Jun and Chung, 2016; Shukla and Tiwari, 2017)
		R&D	(C. K. H. Lee, 2017; Troilo et al., 2017; Yu et al., 2019)
		Logistics and procurement	(Lamba and Singh, 2019; Li and Wang, 2017)
		Marketing and pricing	(Chong et al., 2016; Edwards et al., 2017; Erevelles et al., 2016; Jabbar et al., 2020; Liu et al., 2016; Steinhoff et al., 2019; Wedel and Kannan, 2016; Zhou et al., 2018)
		Operations and production	(Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Zaki et al., 2019)
		Product development and management	Jin et al. (2016)
		Recruiting	(Mahmood and Mubarik, 2020; Sena and Ozdemir, 2020)
		Supply chains	(Aryal et al., 2018; Bansal et al., 2020; Baryannis et al., 2019; Brinch, 2018; Chehbi-Gamoura et al., 2020; Groves et al., 2014; Huang et al., 2018; Ivanov et al., 2019, 2019b; Öberg and Graham, 2016; Roβmann et al., 2018; Sanders, 2016)
		Multiple use cases	(Bălan, 2018; Chen, 2018; Corbett, 2018; Elia et al., 2020; Feng and Shanthikumar, 2018; Fisher and Raman, 2018; Guha and Kumar, 2018; Hartmann et al., 2016; Melander and Pazirandeh, 2019; Nunan and Di Domenico, 2017; Pigni et al., 2016; Raguseo and Vitari, 2018; Sestino et al., 2020; Sorescu, 2017; Swaminathan, 2018; Tachizawa et al., 2015; Vitari and Raguseo, 2020; Wang et al., 2016; Wiener et al., 2020)
		Sold to others	(Tachizawa et al., 2015; Wang et al., 2016; Wiener et al., 2020)
	Collected internally	Customer relationship	(Kitchens et al., 2018; Line et al., 2020; Sivarajah et al., 2020)
		Delivery and after sales	(Mehmood et al., 2017; Opresnik and Taisch, 2015; Ostrom et al., 2015; Seitz et al., 2020; Chaoyang Zhang et al., 2020)
		Forecasting and planning	(Boone et al., 2019; Dubey et al., 2019b; Fang et al., 2020; Lau et al., 2018)
		Governance and regulation	Shukla and Tiwari (2017)
		R&D	(Ghasemaghaei and Calic, 2020; Lee, 2018; Lehrer et al., 2018; Troilo et al., 2017; Wu et al., 2020)
		Logistics and procurement	(Lamba and Singh, 2019; Zhong et al., 2015)
		Marketing and pricing	(Dong and Yang, 2020; Erevelles et al., 2016; Trusov et al., 2016; Wedel and Kannan, 2016; Xu et al., 2016; Yang et al., 2020)
		Operations and production	(Chien et al., 2017; Choi et al., 2018; Cohen, 2018; Farooqui et al., 2020; Frank et al., 2019; Gunasekaran et al., 2018; Gupta et al., 2020; Kuo and Kusiak, 2019; Zaki et al., 2019)
		Product development and management	Hajli et al. (2020)
		Recruiting	Mahmood and Mubarik (2020)
		Sales	Boldosova (2020)
		Supply chains	(Aryal et al., 2018; Baryannis et al., 2019; Brinch, 2018; Chavez et al., 2017; Chehbi-Gamoura et al., 2020; Chen et al., 2015; Dubey et al., 2019b; Jha et al., 2020; Kamble et al., 2020; Kamble and Gunasekaran, 2020; Kinra et al., 2020, 2020b; Öberg and Graham, 2016; Roβmann et al., 2018; Sanders, 2016; Tachizawa et al., 2015)
		Multiple use cases	(Akter et al., 2020; Chandy et al., 2017; Chen, 2018; Corbett, 2018; Dubey et al., 2020; Dutta and Bose, 2015; Elia et al., 2020; Grover et al., 2018; Guha and Kumar, 2018; Gupta et al., 2019; Hartmann et al., 2016; Julsrud and Krogstad, 2020; Kumar et al., 2016; Li et al., 2020; Mikalef et al., 2019; Nunan and Di Domenico, 2017; Pigni et al., 2016; Raguseo and Vitari, 2018; Sestino et al., 2020; Sheng et al., 2017; Sorescu, 2017; Suoniemi et al., 2020; Swaminathan, 2018; v. Alberti-Alhtaybat et al., 2019; Vitari and Raguseo, 2020; Wang et al., 2016; Wiener et al., 2020; Zhang et al., 2019)
		Sold to others	(Cohen, 2018; Guha and Kumar, 2018; Huang et al., 2018; Lau et al., 2018; Opresnik and Taisch, 2015; Wang et al., 2016; Wiener et al., 2020)

The use of big data in private organizations is also related to the business area of supply chains (Chehbi-Gamoura et al., 2020, 2020b; Öberg and Graham, 2016), where the management of vast amounts of information is particularly useful to discover new collaboration partners and improve the use of green resources (Melander and Pazirandeh, 2019). Additional benefits are associated with reducing uncertainty in supply chain operations and increasing transparency between various stakeholders (Roβmann et al., 2018; Chubing Zhang et al., 2020). Thus, in the supply chain area, firms can create value by mapping information about their potential partners; in addition, the establishment of stakeholders' networks can allow these firms to appropriate value from collaboration and knowledge exchange.

In the manufacturing business area, big data can boost agile practices, competitiveness, and performance (Gunasekaran et al., 2018), energy efficiency evaluations, and the detection of production anomalies (Roβmann et al., 2018). In addition, the ability of organizations to be flexible and dynamic allows them to successfully deal with the market turbulence (Gunasekaran et al., 2018). Finally, large amounts of information play a crucial role in assisting in production decision-making (Lamba and Singh, 2019).

In relation to the marketing area, the existing qualitative research has explored opportunities in terms of forecasting demand for new products, along with the possibility of determining the online market potential of new goods (Mariani and Fosso Wamba, 2020). Moreover, in

Table 4
Classification of big data effects (positive vs negative), by methodology and business area.

	Quantitative research	Qualitative research	Mixed research	Conceptual research
Customer relationship	• Demand forecasting (+) • Knowledge of customer attitudes (+)			
Delivery and after sales	• Revenue streams (+) • Interaction with customers (+)		• Innovative ideas (+)	• Revenue streams (+) • Interaction (+)
Forecasting and planning	• Consumption predictions (+) • Performance (+)		• Prediction of sales (+) • Product design (+)	• Long-term profitability (+) • Efficiency (+) • Revenue streams (+) • Servitization (+)
R&D			• Development of capabilities (+) • Creativity (+) • Performance (+) • Privacy and ethics (−)	
Governance and regulation	• Privacy (−) • Tech acceptance (−)			• Detection of anomalies (+) • Data interpretation (+)
Logistics and procurement	• Visualization of logistics (+) • Decision-making (+) • Efficiency (+) • Propensity, amount, and timing of orders (+)		• Demand predictions (+) • Performance (+) • Customer satisfaction (+) • Complexity	• Update and adjustments (+)
Marketing and pricing	• Performance (+) • Customer segmentation (+) • Decision-making (+) • Problem-solving (+) • Demand prediction (+) • Revenue (+)	• Market potential for new products (+)	• Brand management and marketing capabilities (+) • Business effectiveness (+) • Decision-making (+) • Sustainability (+) • Automation (+) • Load traceability (+) • Competitive advantage (+)	• Willingness to pay (+) • Innovative ideas (+) • Customer relationships (+) • Customer prediction (+) • Privacy (−)
Operations and production	• Performance (+) • Technical efficiency (+) • Platform development (+) • Predictions (+) • Identification of anomalies (+)	• Anomalies detection (+) • Support for production decision-making (+) • Agile manufacturing (+) • Performance (+)	• Operational performance (+) • Dealing with complexity (+) • Detection of deviations (+) • Networking (+) • Cost reduction (+) • Decision-making (+) • Product design (+) • Privacy (−) • Social welfare (−)	• Service quality (+) • Monitoring (+) • Misleading results (−)
Product development and management		• Customer agility (+) • Prediction (+)	• Innovation (+) • Productivity (+) • Product design (+)	
Recruiting	• Productivity (+) • Innovation (+) • Technical efficiency (+)			
Sales		• Smart servitization (+)	• Environmental costs (+) • Market info update (+) • Profitability (+)	
Supply chains	• Transparency (+) • Cost reduction (+) • Supplier selection (+) • Performance (+) • Process efficiency (+)	• Collaboration (+) • Resource utilization (+) • Uncertainty reduction (+) • Transparency (+) • Forecasting (+) • Automation (+)	• Procurement costs (+) • Inventory control (+) • Rapid responses (+) • Stakeholder relationships (+) • Social and environmental sustainability (+) • Bullwhip effect (+) • Uncertainty (+) • Collaboration (+) • Knowledge (+) • Innovation (+) • Asset productivity (+) • Business growth (+) • Privacy/security (−)	• Networking (+) • Quality of data coordination (+) • SC visibility (+) • Market response (+) • Adaptation (+) • Visibility (+) • Forecasting (+) • Customer experience (+) • Ethics (−)
Multiple use cases	• Economic and environmental performance (+) • Predictions (+)	• Innovation (+) • Ethical orientation (+) • Stakeholder interactions (+) • Decision-making (+) • Customer engagement (+) • Knowledge of customers (+) • Sustainability of operations (+) • Partnerships (+) • Product and process innovation (+) • Security (+)	• Response to changing environments (+) • Performance (+) • Sustainability (+) • Customer service management (+) • Innovation efficacy and efficiency (−) • Security and privacy (−) • Competitive advantage (+) • Customer satisfaction (+) • Personalized offerings (+) • Forecasting accuracy (+)	• Speed of analytics (+) • Innovative processes (+) • Real-time decision-making (+) • Energy consumption (−) • Sustainability (+) • Customization (+) • Performance (+) • Pricing decisions (+) • Customer insights (+) • Info transparency (+) • Privacy (±)

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Table 4 (*continued*)

	Quantitative research	Qualitative research	Mixed research	Conceptual research
Customer relationships	• Customer experience (+) • Customer satisfaction (+) • Innovation (+)		• CRM performance (+)	• Market complexity (+) • Decision-making (+) • Innovation (+) • Privacy (−)

the manufacturing and marketing areas, firms can potentially innovate their business models through value creation by understanding and analyzing the market based on multiple sources of available data.

4.1.2. Business areas considered and overall effect assessed in quantitative studies

Previous quantitative studies are predominantly based on logistics and production and on the positive impacts that big data has. In relation to the operations and production area, (Chien et al., 2017) demonstrated that the adoption of big data positively correlates with the identification of anomalies in production data, prediction accuracy, and model reliability. More recently, (Dubey et al., 2020) determined that the presence of proactive, innovative, and risk-taking entrepreneurs increases the option to develop BDA to improve operational performance. Big data also provides better detection of possible root causes of excursion, in addition to better production yields (Feng and Shanthikumar, 2018).

In the forecasting and planning area, big data can improve consumption predictions, firm performance in the oil industry (Yu et al., 2019), and the accuracy of consumer demand predictions for TV shows (Liu et al., 2016). Moreover, supply chain professionals can adopt big data to increase firm performance and improve manufacturing processes (Hazen et al., 2014). In the logistics and procurement area, big data also improves the visualization of logistics trajectories, the evaluation of operator efficiency, and the ability to make precise and efficient decisions (Zhong et al., 2015). In addition, (C. K. H. Lee, 2017) stressed benefits to be had in terms of better demand estimation and more effective anticipatory shipping plan development. In some cases, big data is helpful in predicting the propensity, amount, and timing of orders (Huang and Van Mieghem, 2014).

In marketing, both positive and negative effects associated with the use of big data have been discussed by (Shan et al., 2020), who described possible challenges when identifying the most valuable content in the face of copious information that potentially increases opportunities to provide customized and intelligent search services in line with the demands and preferences of users. Thanks to the application of big data, (Trusov et al., 2016) proposed a modeling approach for user profiling that targets individuals and improves the performance of marketing campaigns. Finally, in the area of supply chains, (Lamba and Singh, 2019) presented the 3Vs of big data and proposed a mathematical model to demonstrate that supplier selection management based on big data leads to a general reduction in costs. The collection and interpretation of marketing science articles and tools can influence practitioners' marketing decisions and their ability to solve practical problems (Roberts et al., 2014). Therefore, thanks to the collection and interpretation of big data, value creation and capture processes are enabled not only in operations and production but also in marketing, forecasting and planning, and logistics. Specifically, firms are encouraged to segment and map their customers in order to improve their overall performance.

Multiple use cases with big data were highlighted by (Feng and Shanthikumar, 2018), who discussed the accurate prediction of customer preferences as a support for the design and processing of products and services. Moreover, the development of BDA solutions increases customer satisfaction, as well as market and financial performance (Raguseo and Vitari, 2018). In addition to value creation and capture, the use of big data encourages the delivery of value to customers, since firms can meet demand with personalized services.

4.1.3. Business areas considered and overall effects assessed in conceptual studies

The vast majority of big data research is conducted by adopting a conceptual methodology. Previous conceptual studies mainly discussed the use of big data in relation to the business area of supply chains, in addition to multiple use. Among the positive consequences deriving from the use of large amounts of information, there is a higher likelihood that private organizations will develop BDA capabilities if they decide to adopt a dedicated approach to data management and to use advanced software packages like Microsoft's PowerBI, SAP, or Oracle (Jha et al., 2020). Furthermore, (Bansal et al., 2020) stressed the chance to better understand supply chains as complex adaptive systems thanks to the use of big data. Also, (Brinch, 2018) emphasized the possibility to make better decisions and improve business process outputs. The use of big data in supply chain management can reveal numerous benefits in terms of agility, transparency, efficiency, higher integration among stakeholders, and product design capabilities (Kache and Seuring, 2017). In addition, previous conceptual studies of the effects big data can have on supply chains have discussed the combination with smart cities where the massive information availability can improve supplier network management (Öberg and Graham, 2016). The potential matching between supply and demand has been explored by (Sanders, 2016), who presented a maturity map to theorize subsequent steps in big data adoption (i.e., data structuring, data availability, data analysis, and data management). In relation to the forecasting and planning business area, a study by (Seitz et al., 2020) focused on the value creation opportunities deriving from the use of big data. Specifically, they highlighted an overall improvement in demand fulfilment processes, increasing the efficiency of supply allocation, along with higher services levels.

Little research has focused on big data usage in after sales in the context of private organizations. (Opresnik and Taisch, 2015) reported that the main advantages are increased revenue streams, increased interaction with the customers, and also the opportunity to innovate thanks to the expanded knowledge achieved regarding customer behavior. According to (Ivanov et al., 2019), the analysis and management of big data can improve the coordination of qualified information and supply chain visibility. The dark side of big data use was investigated by (Wedel and Kannan, 2016), who highlighted the ethical issues related to the continuous accumulation and storage of information for purposes that are distant from those of research.

Most conceptual research is based on multiple use cases with big data and the connected potential it has in terms of value creation and value capture. For instance, (Cohen, 2018) widely discussed the opportunity to foster real-time service personalization and advance service quality thanks to greater data available on customers. In the retailing industry, the advantages include more assortment, a better level of prices, a greater ability to quantify the impact of stockouts on lost sales and profits, and the evaluation of delivery time relative to revenues (Fisher and Raman, 2018). Benefits like the increased speed of analytics and the collection of valuable insights available to decision-makers were presented by (Grover et al., 2018). (Shukla and Tiwari, 2017) focused on the sustainable production sector to highlight the importance of developing big data analytics to incorporate smallholders. More recently, (Jabbour et al., 2019) linked the four dimensions of big data – volume, variety, velocity, veracity – to circular economy business models in order to explain their potential to be unlocked. The multiple use of big data can also provide prospects for the improvement of real-time decision-making and greater efficiency due to data sharing (Kitchens et al.,

2018; Nunan and Di Domenico, 2017; Pigni et al., 2016). (Hopp et al., 2018) and (Cohen, 2018) presented some privacy concerns associated with the vast amount of information and they stressed that incorrect data treatment could even affect general performance. Authors like (Corbett, 2018) based their conceptual discourse on problems such as energy consumption and the analysis of wrong data. Ethical issues are recognized by (Nunan and Di Domenico, 2017) who claimed that they mainly depend on weaknesses in organizational processes and systems. The innovation of data-driven business models passes through the analysis of valuable information that, if accurately managed by those with specific competencies, can have the potential to improve the decision-making and the efficiency of firms.

In the marketing area, the collection and management of large amounts of information is associated with the creation of valuable, rare, and imperfectly imitable resources (Erevelles et al., 2016). With high volume and speed of information and knowledge from social media, organizations can tailor their business models to specific market needs (Xu et al., 2016). The similar use of social media is discussed by (Steinhoff et al., 2019) who examined specific software and tools to leverage big data for managing customer relationships. Additionally, the appropriate collection of vast amounts of information enables the achievement of a sustainable competitive advantage (Erevelles et al., 2016). Some of the key aspects considered were an advanced knowledge of customers and the possibility to gather interesting customer insights (Cohen, 2018; Xu et al., 2016). Also in the marketing area, (Martin, 2016) debated potential privacy and responsibility concerns related to big data.

Finally, in the logistics business area, big data can support organizations when calculating the best transportation routes, and in quickly and simultaneously updating the route of logistics terminals (Liu et al., 2020). In sum, in the areas of supply chains, forecasting and planning, marketing, logistics, and after sales, the use of big data is associated with the processes of value creation and value capture that allow firms to innovate their business models. In particular, most studies have emphasized that the establishment of networks and ecosystems is conducive to the sharing of large amounts of information as well as the fostering of reliability among various stakeholders.

4.1.4. Business areas considered and overall effect assessed in mixed method studies

A mixed methodology prevails in the field of big data management in the context of private and public organizations. In particular, the principal business areas studied are manufacturing, marketing, supply chains, and R&D. The huge availability of information on supply chains allows organizations to respond rapidly to changing market conditions and to strengthen relationships with their stakeholders (Gawankar et al., 2020). Also in the area of supply chains, big data can produce remarkable insights more quickly, as suggested by (Lamba and Singh, 2019). A study by (Sivarajah et al., 2020) demonstrated the ability of analytics to enable B2B organizations within a participatory web environment. The environmental aspects of big data are discussed by (El-Kassar and Singh, 2019), who measured the influence of green innovation adoption and supply chain development to explore the use of large data in the relationship between management commitment and HR practices. In relation to the humanitarian supply chains that are formed when military and civil organizations aim to assist in disaster operations, big data can advance information processing, reduce uncertainty, and reinforce collaborations between actors (Dubey et al., 2019c). In the event of excess inventories or inventory shortages, large amounts of information are helpful in mitigating it (Hofmann, 2017). According to (Li and Wang, 2017), the opportunity to develop sensor data-driven dynamic pricing models for food supply chain management supports business managers in making better, fact-based decisions and in increasing their knowledge base. More generally, big data appears to be particularly useful in reducing supply chain costs and efficiencies (Gunasekaran et al., 2017; Hofmann, 2017). Moreover, it can provide better responses and enhance sales and operations planning capabilities when the external environment changes very fast (Gunasekaran et al., 2017). (Akter et al., 2020) demonstrated that big data can support private organizations in changing market conditions. Finally, the aspect of capabilities was studied by (Fosso Wamba and Akter, 2019), who revealed how BDA capabilities help organizations enhance the agility and adaptability of their supply chains in order to achieve superior organizational performance. Thus, the area of supply chains highlights processes of value creation and capture. Specifically, firms can leverage big data to accumulate knowledge about customers and suppliers. Likewise, the information acquired can be used to improve decision-making as well as to enhance collaboration between various stakeholders.

In the marketing and pricing business area, (Chubing Zhang et al., 2020) argued that the availability of more information improves understanding of customer needs and business effectiveness. Furthermore, an appropriate strategic data-driven approach amplifies the ability to monitor products and the capability to trace loads through the automatized scheduling of purchases (Troisi et al., 2020). When considering the amazing advancement of technological innovations, (Frank et al., 2019) found that big data improves operational aspects and increases worker productivity by leveraging artificial intelligence, industrial robots, and other forms of automation. More recently, (Yang et al., 2020) studied the use of emails as potential sources for capturing valuable business information like that regarding the most profitable activities. According to (Dong and Yang, 2020), the management of data deriving from the use of social media has a positive effect on market performance. By using a multi-industry dataset from more than 400 B2B organizations, (Hallikainen et al., 2020) provided positive results in terms of customer relationship performance and sales growth. Thanks to the adoption of machine learning techniques, content generated by users can offer potential benefits in terms of higher knowledge about customers and firm stock performance (Liu, 2020). Thanks to the use of big data, predictions of customer and competitor behaviors are more accurate, and performance is higher (Lau et al., 2018). (Jabbar et al., 2020) adopted a problematization approach to explore the links between big data, programmatic marketing, real-time processing, and decision-making processes. In the area of marketing and pricing, firms not only have the potential to collect information from various sources (e.g., social media) to improve their understanding of the market (value creation), but they can also leverage the same information to increase profits (value capture) and reinforce customer relationships (value delivery). Thus, the ability to acquire and interpret big data is associated with the opportunity to better meet and satisfy demand.

In relation to the R&D business area, previous studies focused on the role big data has in accelerating a firm's incremental and radical innovative capabilities (Mikalef et al., 2020). (Zhang and Xiao, 2020) argued that big data facilitates new product performance and generates creative output in innovating B2B. Other potential benefits are related to the improvement of exploration and exploitation, which constitute a firm's innovation competencies and are therefore critical factors to gain a competitive advantage (Ghasemaghaei and Calic, 2019). According to (Mikalef et al., 2019), when it is possible to collect vast amount of information, organizations can increase their understanding of fast changing environments and their ability to acquire rapid insights. Big data was connected with the entrepreneurial orientation of private organizations in the analysis conducted by (Dubey et al., 2020); the presence of entrepreneurial traits like "pro-activeness," "risk taking," and "innovativeness" are vital when adapting to environmental changes and thus improving decision-making. The ability to predict market demand is debated by (Huang et al., 2018) who used a systematic approach to show that substantial wealth redistribution and early detection of threats are stimulated. (Zhang et al., 2019) considered negative effects by focusing on privacy concerns and ethical challenges; they recommended that superior levels of cybersecurity should be established. In R&D, big data is mainly linked to the opportunity to create value from the interpretation of large amounts of information.

By analyzing big data multiple use cases, positive impacts have been identified in the ability to follow growing customer demands (Vitari and Raguseo, 2020). Previously, (Johnson et al., 2017) stressed the concepts of data variety and data velocity to emphasize the optimistic effects of big data in terms of innovation efficacy and efficiency. Moreover, (Johnson et al., 2017) revealed that superior performance is strongly dependent on big data capabilities, especially in case of turbulent customer environments. A specific category of capabilities – operational ones – is reinforced by integrating tangible, human, and intangible big data resources, as illustrated by (Dubey et al., 2019a). Multiple big data use is also explored in the field of green products, where predictive analytics positively influence organizational performance (Shen et al., 2019). The improvement of marketing operations, as well as various benefits in terms of environmentally sustainable procurement and logistics operations were explored by (Choi et al., 2018). In healthcare, big data not only encourages more information integration but also improves efficient medical resource usage, even though privacy abuses and increased security threats can emerge (Chen, 2018). (Foster et al., 2018) studied the health system by proposing an index based on big data that is useful in identifying various factors that improve physician performance and supporting its measurement. In the casino industry, the improvement of regulation and policy is intensified thanks to the use of big data, as suggested by (Kim and Lee, 2016). In this case, the ability to increase networking and interaction accelerates the emergence of a unique system composed of education, corporation, and government. In retailing, the collection of customer data on a large scale allows retailers to manage service customers more effectively in stores (Aloysius et al., 2016). The dark side of big data in multiple business areas was examined by (Ghasemaghaei and Calic, 2020). They found data volume negatively impacts both innovation efficacy and efficiency, while data variety and velocity enrich overall performance. The effects of big data use range from the creation of value in the development of specialized capabilities to the appropriation and delivery of the value created. In fact, firms can use large amounts of information to increase their performance and improve interaction between ecosystems (value capture). Moreover, customers benefit from the use of big data since they can be easily served and satisfied (value delivery).

Another fruitful field of research is the use of big data in forecasting and planning, where the opportunity to create value from large amounts of information is prominent. For instance, (Chong et al., 2016) demonstrated that the processing and analysis of consumer opinion data is beneficial in designing market-driven products. In the product development and management area, (Jin et al., 2016)) showed that the opportunity to appropriate value through higher productivity comes from the interpretation of massive consumer opinion data records. In sales, (Suoniemi et al., 2020) built on the resource-based view to indicate it is possible to update market information very frequently by investing in big data. In operations and production, (Dubey et al., 2019b) presented organizational culture as one of the key factors influencing technology and big data to improve costs and operational performance. More recently, (Farooqui et al., 2020) studied the positive association between big data and higher detection of deviations in operation sequences. Potential negative effects were mentioned by (Wamba et al., 2017), who considered the difficulty of capturing value from big data when environments are highly structured. Finally, the discovery of innovative service ideas and the advancement of service delivery are possible values linked to the collection of big data in the delivery business area (Ostrom et al., 2015). Thus, the creation and appropriation of value has been stressed. Specifically, firms can leverage big data to accumulate knowledge of operations and improve their performance.

4.2. Big data use in public organizations

Big data adoption in the context of public organizations varies considerably across business areas. Most of the literature in this field is based on qualitative and conceptual methods that aim to identify the beneficial aspects of big data multiple use. As regards mixed analysis, the areas of R&D and supply chains have been explored extensively. In the sub-sections that follow, we develop a classification of the most common research methodologies to explore the overall effects that the use of big data can have on diverse business areas in public organizations.

4.2.1. Business areas considered and overall effect assessed in qualitative studies

The positive consequences of big data in multiple use cases were qualitatively explored by (Gupta et al., 2019), who presented the potential of vast amounts of information to improve business operations through data-driven decisions. Encouraging effects in terms of customer engagement, the generation of interesting insights, understanding marketing trends, and faster demand response are discussed by (Zaki et al., 2019). In the same year, (v. Alberti-Alhtaybat et al., 2019) investigated the opportunity to tailor services to specific customer needs. In the travel industry, the role of big data is crucial to help destination management organizations and tour operators to recognize existing and emerging tourism issues and be competitive (Edwards et al., 2017). (Sorescu, 2017) associated the concept of BMI with the processes of collecting, organizing, and summarizing external and internal data to create value for customers. According to (Dutta and Bose, 2015), some examples of critical factors in big data are the growth of sales and the acquisition of new customers. Finally, big data has the potential to provide security, mitigate forms of environmental damage like pollution, and improve services. More generally, it can support the integration of services and transport in smart cities (Julsrud and Krogstad, 2020). Firms that use big data for multiple purposes in public organizations have the potential to create value thanks to a better understanding of the market, and they can appropriate and deliver the value created by improving their decision-making and thus meeting customer needs.

The application of big data in supply chains was studied by (Melander and Pazirandeh, 2019), who emphasized that new collaboration partners who focus on big data are likely to improve green strategies and resource utilization. In addition, (Roβmann et al., 2018) conducted semi-structured interviews to highlight the higher accuracy of forecasting, the reduction of uncertainty in supply chain operations, the increased transparency of supply chains, and the increased automation of operational tasks and decisions thanks to the use of big data. To automate supply chain processes, designers should analyze market dynamics in order to compete successfully (Groves et al., 2014). The use of big data can yield higher levels of value creation and value capture in supply chains. For instance, by observing customer trends, firms can better predict demand and better respond to emerging needs.

In sales, (Boldosova, 2020) emphasized the opportunity to facilitate smart servitization and customer adoption of smart services. Big data has also been linked to the business area of operations and production; the implementation of agile practices is encouraged in the context of turbulent environments. Agile manufacturing is deployed and performance increases (Gunasekaran et al., 2018). The use of big data in product development and management has recently been studied by (Zaki et al., 2019), who associated the massive sharing of information with the development of customer agility and predictions of new product success. Thus, in the areas of sales, operations and production, and product development and management, the opportunity to share the data collected is associated with the opportunity to appropriate the value created by improving a firm's overall performance.

4.2.2. Business areas considered and the overall effect assessed in quantitative studies

Quantitative research on big data in public organizations is common in the customer relationship area and quite frequent in forecasting and planning, and in operations and production, even though the majority of the studies was published in relation to big data multiple use cases.

Differently from the context of private organizations, quantitative analysis in public organizations does not report any issues or concerns related to big data.

As regards the customer relationship area, (Lee et al., 2019) suggested the importance of understanding large amounts of data to improve hotel guest experiences and to investigate specific customer attributes (e.g., feelings) that contribute to higher satisfaction. (Zhou et al., 2018) examined the key outcomes of big data, such as a more comprehensive understanding of the market and therefore the power to produce innovative ideas. In the same area, the analysis of search traffic makes it possible to forecast demand and map past and present customer attitudes (Jun et al., 2014). Big data multiple use cases can offer higher levels of customer satisfaction (Lamba and Singh, 2019; Raguseo and Vitari, 2018), as well as better market and financial performance (Raguseo and Vitari, 2018), and enhanced predictions (Liu et al., 2016). BMI can be achieved through value creation, value capture, and value delivery in the area of customer relationships and thanks to big data multiple use cases; in fact, firms can improve customer satisfaction by interpreting large amounts of individual information and behaviors.

In operations and production, using a survey of Chinese manufacturing firms, (Li et al., 2020) empirically demonstrated that big data advances the establishment of supply chain platforms in the era of Industry 4.0, the achievement of competitive advantages, and the promotion of sustainable development. The identification of anomalies in production data, but also higher prediction accuracy, are some of the possible benefits deriving from the use of big data, as discussed by (Chien et al., 2017). According to (Feng and Shanthikumar, 2018), the proper detection of the possible roots of anomalies and the improvement of production yield can be associated with big data. As demonstrated by (Fang et al., 2020), big data collection influences the accuracy of manufacturing prediction system and ensures higher reliability of models. More recently, (Dubey et al., 2020) discovered that overall decision-making can be enriched because entrepreneurial orientation makes it possible to explore and exploit technological advancements like BDA. In operations and production, the development of ecosystems encourages value creation and value capture. Specifically, firms can cooperate with their stakeholders to ensure the efficiency and sustainability of processes.

In terms of the business area of recruiting, (Sena and Ozdemir, 2020) highlighted progress in operational performance, especially in less dynamic environments. In the same year, (Mahmood and Mubarik, 2020) stressed the importance of developing a broad set of capabilities to capture the opportunities deriving from business digitalization. In forecasting and planning, big data is useful to predict oil consumption behavior via trend observations, as well as the performance of organizations (Yu et al., 2019). In the areas of operations and production, recruiting, and forecasting and planning, processes of value creation and value capture have been underscored; firms can in fact leverage their resources and competencies to improve their performance. Some concerns have emerged regarding the use of big data in the business area of governance and regulation, where (Julsrud and Krogstad, 2020) called for new governance models to increase citizen trust as well as their acceptance of technology. In logistics and procurement, the main positive consequences are correlated with the development of advanced decision-making processes and the ability to make precise and efficient decisions (Zhong et al., 2015). Big data is helpful in predicting the propensity, amount, and timing of orders, according to (Huang and Van Mieghem, 2014). By using the three-dimensional approach to big data in supply chains, a mathematical model has been proposed by (Lamba and Singh, 2019) to emphasize the outcome of good supplier selection management, which frequently results in cost reductions.

In the areas of governance and regulation, logistics and procurement, as well as supply chains, there are opportunities to create, capture, and deliver value from big data. These can be attributed to firms' ability to manage massive amounts of information, which produces higher customer reliability and decision efficiency. In marketing, (Trusov et al., 2016) recommended a modeling approach to profile users and – thanks to the management of large amounts of information – to categorize individuals. This preliminary analysis allows firms to increase their knowledge of their customer base. Finally, in the study by (Yang et al., 2014), the interpretation of web traffic data improved the prediction of hotel demand, revenues, and performance.

4.2.3. *Business areas considered and overall effects assessed in conceptual studies*

The conceptual discourse around big data mainly concerns the business area of supply chains, where benefits in terms of forecasting, decisions, and market responses have been debated. For instance, (Jha et al., 2020) argued that a higher level of BDA capabilities can be found in organizations where a dedicated approach to data management has been established. That same year, (Bansal et al., 2020) theorized that supply chains should be interpreted as complex adaptive systems that can generate large data volumes regarding "supply chain emergence, functioning, and adaptation" (Bansal et al., 2020). The positive impacts of BDA (e.g., in terms of demand forecasts, supply chain visibility, customer experience, and promotions) have also been studied to analyze the improvement of forecasting models (Ivanov et al., 2019). In the same area, the most widely discussed positive outcome is rapid response to market demand (Kumar et al., 2016), as well as the strengthening of supplier network management if smart cities are combined with big data (Öberg and Graham, 2016). According to (Sanders, 2016), vast amounts of information can provide better matching between supply and demand, higher coordination of various supply chain functions, and the application of targeted tactical activities. More recently, (Brinch, 2018) discussed the concept of big data in relation to the constructs of *value discovery, value creation,* and *value capture*. In general, the collection and interpretation of big data in the supply chain field is linked to processes of value creation, value capture, and value delivery. In fact, firms can invest in their competencies (e.g., BDA) to accumulate knowledge on the market and provide customized offerings.

The conceptual debate around big data is also related to multiple use cases of this technology, where (Jabbour et al., 2019) considered both positive and negative effects of big data by applying the four dimensions – volume, variety, velocity, veracity – to circular economy business models, and thus providing insights into the possibility to enhance social and environmental sustainability. Being able to produce and collect interesting customer insights is discussed by (Kitchens et al., 2018; Lehrer et al., 2018; Steinhoff et al., 2019). According to (Corbett, 2018), big data should be managed in a sustainable way; for instance, it can support humanitarian operations through the forecasting of societal needs. In some cases, big data can offer real-time service personalization and even improvements in service quality thanks to the increasing availability of information on customers (Cohen, 2018). Moreover, several benefits in retailing have been considered; in fact, (Fisher and Raman, 2018) referred to the better management of assortments, store closing and pricing decisions, and the quantification of stockouts and related impacts on sales and profits. In the same year, (Hopp et al., 2018) emphasized the increasing likelihood and speed of achieving good outcomes in precision medicine. Benefits in the speed of analytics and in accessibility to improving insights exponentially for decision-makers were reported by (Grover et al., 2018). A BDA framework was recommended by (Shukla and Tiwari, 2017), who argued that large amounts of information are useful to incorporate smallholders in sustainable production. At the same time, big data can help decision-makers to properly address great challenges like poverty, illness, and conflicts (Chandy et al., 2017; Swaminathan, 2018). Progress in real-time decision-making and greater efficiency have been linked to data sharing across multiple business areas, as suggested by (Pigni et al., 2016). The dark side of big data was revealed by (Grover et al., 2018) in terms of data protection and privacy issues. In addition, potential privacy concerns linked to marketing relationship performance were presented by (Steinhoff et al., 2019). The likelihood of incomplete and inaccurate data and privacy

concerns emerging was discussed by (Hopp et al., 2018). Ethical issues regarding big data (e.g., risk in the rapid spread of big data around the world) could depend on weaknesses in organizational processes and systems (Nunan and Di Domenico, 2017).

The use of big data in the customer relationship area is largely based on the prediction of behavior and on the level of information that makes determined strategic business decisions possible (Kitchens et al., 2018). (Xu et al., 2016) argued that an increasing product success is feasible when multiple stakeholders exchange information. According to (Lee, 2018), the development of an innovative model is useful in making better decisions and having better business process outputs. In data-rich environments there is the chance to tailor models to specific market needs ((Wedel and Kannan, 2016). The role of online relationships was debated by (Steinhoff et al., 2019), who stressed the importance of big data in developing such connections but also that potential privacy concerns among customers can impede the formation of online relationships.

Big data multiple use cases and the adoption of big data in the customer relationship area can lead to the innovation of business models achieved through value creation and value capture. Specifically, a heightened understanding of the market enables firms to improve their decision-making as well as to better meet customer needs. In marketing, in addition to a greater understanding of buying behaviors, enhanced decision-making, and the advanced tracking and traceability of marketing decisions, the use of big data can contribute to the creation of valuable, rare, and imperfectly imitable resources ((Erevelles et al., 2016).

Only one study has been published in the area of R&D. (Lehrer et al., 2018) concluded that big data facilitates the generation of customer insights and the understanding of customer needs. Likewise, one research study is available in the area of governance and regulation, where either positive or negative effects were associated with the possibility or not of easily detecting and judging anomalies (Flyverbom et al., 2017). Thus, big data is helpful in enhancing the value creation process of firms in the areas of marketing, R&D, and governance and regulation.

In forecasting and planning, (Seitz et al., 2020) presented optimistic outcomes like the upgrading of demand fulfilment processes, efficient supply allocation, and a high level of services that, in turn, increases the long-term profitability of organizations thanks to the use of big data. In operations and production, the appropriation of the value created by leveraging big data strategy is translated into expanded revenue streams and profitable servitization (Opresnik and Taisch, 2015). The use of big data in operations and production has been studied in relation to the healthcare industry, where better quality of the care provided and enhanced monitoring of global diseases were described (Guha and Kumar, 2018). On the other hand, the creation of misleading results has been emphasized.

4.2.4. Business areas considered and overall effects assessed in mixed studies

With mixed methodology, the most widely discussed business areas that make use of big data are logistics and procurement, supply chains, and R&D; similarly, big data multiple use cases have been debated. As regards logistics and procurement, big data offers various benefits in terms of the prediction of future product demand thanks to the use of historical data, but also in terms of inventory efficiency (Kumar et al., 2020). Previously, (Lau et al., 2018) debated and demonstrated an improvement of sales forecasting performance and greater customer satisfaction. Big data is also useful to predict demand for electronic products via online marketplaces (Chong et al., 2017). The collection and management of valuable information on rival hotels can increase the likelihood that optimal room charges and expected sales can be predicted, according to (Saito et al., 2016). (Chong et al., 2016) argued that positive effects in predicting product sales derive from the "interplays between online reviews, sentiments and online marketing promotional strategies" (Chong et al., 2016). More recently, (Kinra et al., 2020) presented a combination of machine learning techniques and automated big data textual approaches to improve logistics assessments, reduce global supply chain complexity, and better cope with complexity. Value creation, value capture, and value delivery processes have thus been emphasized to demonstrate how firms can innovate their business models by leveraging big data. Specifically, in logistics and procurement, organizations can collect vast quantities of information, establish flexible practices, and ultimately increase the level of customer satisfaction.

There has been quite extensive research grounded in the use of big data in marketing. (Jabbar et al., 2020) underscored the probability that this technology could minimize latency in decision-making as well as possible disruptions in customer targeting. In the same area, (Sivarajah et al., 2020) explored the context of B2B organizations to stress the "ability" of big data and social media analytics to foster business sustainability, and to provide opportunities in terms of sustainable marketing and operations. (Troisi et al., 2020) took advantage of the chance to use automatized scheduling of purchases to deliver not only detailed monitoring of products but also superior traceability of loads. According to (Yang et al., 2020), large amounts of data on the most profitable activities can constitute valuable business information to capture. Finally, there has been debate surrounding the positive effects that the synergic use of social media channels and BDA can have on market performance (Dong and Yang, 2020).

Another fruitful area is operations and production. The use of big data can support the detection of determined operation sequences and the identification of patterns in the manufacturing process, even though it is more challenging to identify benefits in a highly structured environment like the manufacturing industry (Farooqui et al., 2020). In 2017, (Mehmood et al., 2017) investigated the match between transport demand and city transport service provision to show that new models for future city operations systems can be designed. (Dubey et al., 2019a) demonstrated that big data can mainly improve costs and operational performance in the context of public organizations. (Frank et al., 2019) found that large amounts of information improve operational aspects and optimize decision-making. An analysis of large-scale enterprises was offered by (Choi et al., 2018) to demonstrate that big data is beneficial for developing strong collaborations and for designing new products. On the other hand, social concerns such as data privacy, human threats, and social welfare have also been presented (Choi et al., 2018).

As regards the supply chain business area, (Dubey et al., 2019c) focused on big data and the humanitarian supply chain to show the opportunity to improve the processing, reduce uncertainty, and strengthen collaborations. The possibility of reducing the bullwhip effect that can lead to excess inventories or inventory shortages was discussed by (Hofmann, 2017). In the same year, (Li and Wang, 2017) presented the very practical effects of big data by developing a sensor data-driven dynamic pricing model for food supply chain management. The opportunity to create organizational value in supply chain management was documented by (Chen et al., 2015), with big data having a positive influence on asset productivity and business growth. Finally, considerable progress in terms of quality, delivery, flexibility, manufacturing capabilities, and costs have been discussed by (Chavez et al., 2017). Thus, most of the research published relating to marketing, operations and production, and supply chains has been based on the innovation of business models through value creation and value capture.

The R&D business area is characterized by i) a higher understanding of a rapidly changing environment, ii) the ability to increase the speed with which insights are generated, iii) real-time monitoring, and iv) the identification of operational inefficiencies (Mikalef et al., 2019). (Huang et al., 2018), thanks to the widespread use of big data, predictions are more correct, substantial wealth redistribution has been documented, and threats can be detected early. Previously, (Ostrom et al., 2015) had reported enhancements in service innovation at incumbent firms, in addressing customer needs in novel ways, and in overall optimization of

the service delivery process. (Wu et al., 2020) recently proved that BDA skills improve existing products and processes. The main concerns in this area were emphasized by (Zhang et al., 2019) in terms of data privacy issues and ethical challenges, and by (Huang et al., 2018) in terms of privacy abuse and security threats. In the area of R&D, firms can leverage big data to innovate their business models by creating, capturing, and delivering value for various stakeholders. Specifically, information sharing is highly encouraged to improve offerings and reduce potential challenges.

Within the area of governance and regulation, the development and customization of services for individual citizens and awareness of public majority opinion have been accelerated by big data (Jun and Chung, 2016). Only one research case has been published in the product development area, where (Jin et al., 2016) argued that processing and analyzing consumer opinion data can provide positive consequences in terms of market-driven product design. In terms of sales, (Lamba and Singh, 2019) studied the manufacturing industry to emphasize the possibility that updated market information can be managed frequently and argue that it is useful to improve profits and environmental costs. Thus, value creation and value capture processes have been highlighted in the areas of governance and regulation, product development, and sales.

In the customer relationship area, BDA can indirectly influence customer relationship management performance in B2B markets by improving the analytics-based vision and orientation of the employees (Chubing Zhang et al., 2020). Value delivery, in addition to the value creation and value capture processes, is mainly associated with BMI in the customer relationship area, where firms can leverage BDA competencies to strengthen their connections with customers.

Multiple use cases with big data have recently debated by (Vitari and Raguseo, 2020), who analyzed specific environmental characteristics to explain the possibility that big data could generate a competitive advantage. The growing availability of information encourages the customization of products for specific targets, according to (Akter et al., 2020). Big data multiple use cases and predictive analytics are expected to influence organizational performance and have a marginal direct effect on green practices and processes (El-Kassar and Singh, 2019). That same year, (Shen et al., 2019) considered the impact of big data by addressing marketing operations improvement, in addition to environmentally sustainable procurement and logistics operations. By providing a framework to systematically analyze big data business models, (Hartmann et al., 2016) revealed that better competitive positioning and superior identification of potential gaps in the market are possible benefits for startups that make use of big data. Finally, more integration among different players and information leads to the efficient use of medical resources, which, in turn, reduces “the uncertainty of investing in medical big data industry, the waste of resource and improve the development barriers of medical big data” (Chen, 2018). When big data is used for multiple purposes, firms are able to create value and appropriate the value created by improving their practices and increasing the efficiency of resource management.

5. Discussion and considerations for future research

The connection between BD and BMI is a relatively new research area. The systematic literature review we have conducted allows us not only to comprehensively map the potential of big data applications for BMI as they have so far been considered by previous researchers, but also to draw attention to promising avenues that can advance research in the field. In this manner, our review fundamentally advances overall understanding of big data and BMI within organizations. The outcomes suggests that there is a great deal of potential to revolutionize the way in which companies create, capture, and deliver value by leveraging big data.

Starting from existing knowledge on big data and BMI, we first identified a final number of 311 studies, including both private (n = 170) and public (n = 161) organizations, and we highlighted the way big data was collected in these. Most of the research on private organizations is based on the internal collection of big data, while 71 studies related to the external acquisition of data. Likewise, most public organizations collect big data internally, and 69 papers involved the external acquisition of large amounts of information. To sum up, most studies focused on private organizations, which calls for further attention towards public firms. In addition, while this study concentrates on a comparison between private and public organizations, future research could consider the use of big data in relation to different types of ownership, governance, and management. For instance, the ability to collect and interpret big data can be compared in family and non-family firms. Moreover, it could be fascinating to understand which specific resources and competencies are needed to fully capture value from big data in these types of organizations. Future studies could also explore the role that the specific resources and competencies of private and public organizations can play in the use and deployment of big data for BMI. Finally, the most common positive effects and drawbacks can be identified based on the type of structure considered.

Secondly, we have dissected the overall effects big data for firms. Most of the papers highlighted the positive consequences that derive from the collection and use of big data, while only 11 studies considered concerns associated with the big data phenomenon, i.e., related to privacy, security, governance, and ethical issues. Consequently, even though recent research has also started to reveal the dark side of big data by considering its drawbacks, the majority of studies only investigated the benefits of big data. As companies may experience huge costs related to big data, due to privacy or security issues, these considerations could be strengthened. Therefore, the scarcity of papers examining the dark side of big data calls for future research to understand how an adequate management of large amounts of information can be fruitful. For instance, what are the most commonly discussed criticalities associated with the management of vast amounts of information? How can specific issues be solved when dealing with big data?

Thirdly, we have analyzed which types of methodology have been adopted so far. We found that the mixed approach is the most commonly adopted for both private (n = 46) and public organizations (n = 36), while the conceptual discourse approach is more common in the context of public organizations (n = 34) than in private ones (n = 25). In addition, qualitative methodology has been little used so far, both in the case of private organizations (n = 18) and public organizations (n = 13). With regard to quantitative methodology, we found that 14 studies have been published in the context of private organizations and a total of 20 in the context of public ones. Despite the fact that most of the existing research adopted mixed methodologies, future studies could develop quantitative analyses by measuring the principal costs connected with the use of big data and by investigating the relative value monetization. Also, innovative methodologies like text scraping via programming languages (e.g., Python) could be conducted to explore the most widespread trends in the big data phenomenon. We contend that a comprehensive set of methodologies must continue to be adopted to further advance our understanding of the impact that big data has on BMI, both inductively and deductively.

We next analyzed the research on big data with regard to the business areas for which it has been considered. In order to have a clear identification of the possible business areas in which big data might be involved, we relied on a survey administered to managers. Most research on big data has considered multiple business areas simultaneously (n = 44). We found this approach in 18 studies about private companies and 26 studies about public companies. In addition to multiple use cases with big data, the most common business areas considered across the studies were supply chains (n = 20), operations and production (n = 12), engineering and technical analysis with 1 study, sales and recruiting with 2 papers each, and product development and management with 4 papers, suggesting areas of research that are still relatively unexplored. No research on big data has yet been published in the accounting and

finance area and this could be due to the exclusion of articles published in the "Economics, Econometrics and Finance" subject area. In particular, we have emphasized that most studies involved big data multiple use cases, which indicates that further efforts should be devoted to business areas like accounting and finance, engineering and technical analysis, sales, recruiting, and product development and management. For instance, in the accounting and finance area, the use of information can be useful not only to monitor budgets and tax expenses but also to decrease fraud as well as to develop high-quality reports. In addition, future research could deepen the theoretical discourse and the empirical analysis of big data applications in management and financial fields by investigating the use of big data for the identification of metrics useful in supporting managerial decisions and evaluating the achievement of Sustainable Development Goals (SDGs). Likewise, in sales, big data has the potential to tailor offerings to specific customers based on real-time information. Finally, engineering and technical analysis could extract the highest value from big data since customized solutions can be provided based on an appropriate interpretation of information; at the same time, a number of problems could be solved, and possible correlations between big data and business strategies could emerge.

Our decision to categorize big data findings into business areas and methodologies stems from the need to map out individual needs. For example, managers specialized in a single area could be interested in understanding the potential of value creation, value capture, and value delivery through the use of big data in the area they are involved in. In addition, this categorization allows us to better depict the effects of big data and to identify promising avenues for future research on big data and BMI. The findings of our study provide many contributions for scholars, practitioners and policymakers, as detailed below.

5.1. Contributions for theory

This systematic literature review contributes to the creation of current and future knowledge on big data by clarifying its effect on BMI considering the different types of business areas, firms, and research methodologies adopted. Thus, the outcomes of this study emphasized the opportunities offered by big data for innovating BMs. In this manner, we contribute to scientific understanding of the phenomenon by providing a detailed map of the current state of scholarship, in order to shed further light on big data and its role in value creation, capture, and delivery. In addition, we can also inspire future research directions in this field of study.

Moreover, the methodology used for this study aims to contribute to what has been done so far in other literature reviews. Indeed, whereas keywords are typically chosen based on the inclination of researchers, we have validated this step by collecting keywords from managers. In this way the list of keywords can be more representative of a managerial audience, rather than being focused only on scholarly outcomes. Our key insight is that this methodology aims to advance best practices for conducting literature reviews and thus present a new standard that may be applied in future research.

5.2. Contributions for practice and policymaking

This research also offers interesting insights for managers and policymakers. Indeed, our map of the various uses of big data provides advice and suggestions for the possible use of big data in organizations. Our identification of ways to collect big data and the areas in which big data is used may indeed facilitate BMI. In addition, while big data has mainly been considered to be beneficial for firms, this study also warns managers to pay attention to the dark side of big data. Nonetheless, even though a few studies have highlighted these aspects, the benefits of BD may outweigh the drawbacks, if properly managed. Thanks to this, managers can better plan the collection, management, and interpretation of big data to create, capture, and deliver value.

In addition, policymakers can better understand impacts and potential applications of big data; we therefore encourage them to properly plan interventions to favor the conscious use of big data. Evidence of the ferment around these topics was provided by recent EU-funded projects like Big Data Innovation Hubs[2] or the Chinese Action Framework for Promoting Big Data, to catch the global wave of big data (www.gov.cn, 2015). Therefore, considering the many appeals made worldwide by governments to advance the collective knowledge of big data, our research further highlights the need to progress in this direction with a comprehensive understanding of the effects big data can have for BMI.

6. Conclusions

The global amount of data is rapidly expanding, and companies seek to understand how to create, capture and deliver value from this information. There are many aspects that may be considered in the utilization of big data, and we have contributed in this direction with our study. We have provided a comprehensive overview of i) the effects produced by big data, including benefits as well as drawbacks, ii) the business areas in in which big data is used, iii) the research methodologies adopted thus far by previous studies (quantitative, qualitative, conceptual, and mixed), and iv) the type of firm considered so far, distinguishing between private and public. Thanks to these categorizations, we have outlined the state of scholarship regarding big data, which benefits overall scientific understanding of the phenomenon and inspires avenues of research that should be further analyzed. At the same time, our review provides clear advice for manager and policymakers on how to benefit most from big data and how to successfully intervene to fully exploit its potential.

Notwithstanding the merits of our study, there are some limitations that also pave the way for future advancements. First, while we have focused on business areas where big data can be applied, considering the benefits and drawbacks, the type of firm, and the research methodology adopted by previous studies, future researchers could classify the different types of theories that have been used so far to study big data. Such an analysis would further contribute to our understanding of the big data phenomenon. Moreover, while we conducted our literature review in the broad field of management, future reviews could explore the role of big data in various other specific sectors, as they could be more informative in a narrower context. In addition, we only selected articles and reviews for this analysis, while books and conference proceedings were excluded. Future studies could also consider these other types of publications to enrich understanding. Finally, the absence of research published in the accounting and finance area could be linked to the exclusion of the "Economics, Econometrics and Finance" subject area from the Scopus search engine, even though it is an area that could produce interesting insights.

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Declaration of competing interest

None.

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