



# Applications of big data in emerging management disciplines: A literature review using text mining

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## ABSTRACT

The importance of data-driven decisions and support is increasing day by day in every management area. The constant access to volume, variety, and veracity of data has made big data an integral part of management studies. New sub-management areas are emerging day by day with the support of big data to drive businesses. This study takes a systematic literature review approach to uncover the emerging management areas supported by big data in contemporary times. For this, we have analyzed the research papers published in the reputed management journals in the last ten years, first using network analysis followed by natural language processing summarization techniques to find the emerging new management areas which are yet to get much attention. Furthermore, we ran the same exercise in each of these management areas to uncover these areas better. This research will act as a reference for future information systems (IS) scholars who want to perform analysis that is deep-dive in nature on each of these management areas, which in the coming times will get all the due attention to become dedicated research domains in the management area. We finally conclude the study by identifying the scope of future research in each of these management areas, which will be a true value addition for IS researchers.

## 1. Introduction

The role of Big Data (BD) in driving business revenue, operation, and customer support has attracted the attention of management scholars in the information systems (IS) domain in the last decade. Several existing organizations in the business and new organizations starting fresh are investing in building Big Data Analytics (BDA) capabilities. The motive is to derive actionable insights with the volume, variety, and veracity of data and enable the individuals or organizations to take and communicate informed decisions (Constantiou & Kallinikos, 2015). With the rapid increase of the processing power available at the hand of an analyst, the motivation to use the data across the smaller day-to-day management areas has become a need for organizations. These everyday management activities supported by BDA have now significantly evolved as full-blown management domains that still tie to conventional management theories. However, there is not much research that uncovers these contemporary management emerging management areas leveraging the full potential of effective BDA techniques.

Despite the boost BDA has received in the recent past, the problem of examining the management applications of BDA under several conditions is still underexplored. Most of the past studies focus on BDA's algorithms and intelligence aspect (Shilo et al., 2020; Kolajo et al.).

While few of the other studies relate the adoption of BDA to human skills required to execute the same from an organization point of view (Inamdar et al., 2020; Lunde et al., 2019). Subsequently, the interplay of these resources (algorithms and intelligence aspect with the management within organizational aspects) remains a reasonably underexplored area (Hossain et al., 2020).

Text-based information retrieval or multimedia (image and video) based information retrieval has become an integral part of most research areas in the analytics domain over the last decade. The rapid and steady growth of text and multimedia data with the development and increase in internet penetration has created the need to develop the BDA frameworks to be analyzed across various management domains. Several programs and tools have been designed to formulate, query, and process multiple BD vis-à-vis text and multimedia facets. This further enables three different kinds of analytics using BD. These are namely: descriptive analytics such as reporting, dashboarding, and visualizations, followed by discovery analytics which captures early signals through text summarizations, feature extraction from image and video, and third being predictive analytics primarily driven from a range of econometrics models to complex machine learning models.

With the recent advances of user-friendly BD processing software and hardware, there is a growing conversation of BDA among business

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heads (Gupta & George, 2016), while at the same time, there is minimal work grounded on management domains, applications, and theories. The lack of exploration of BDA applications in some of these new management domains, or not entirely define management areas, hinders IS or overall management scholars' significant research on the value of BDA. This leaves the management practitioners to navigate through the uncharted territories on trial and learn approach, which not takes a substantial amount of time and requires enormous investment. Hence, building a solid foundation of theoretical and managerial frameworks and identifying areas for future IS scholars to research depends on how the core application and management artifacts are learned and understood (Constantiou & Kallinikos, 2015).

To this far, BDA applications have been explored only in private sectors' management practices with the massive growth of data getting recorded daily (Yaqoob et al., 2016). This leaves a considerable research gap, even in the public sector management domains that could use BDA's capabilities to solve and cater to issues. This, in turn, could evolve some of the contemporary management domains even in the public sector. To attract future IS researchers' attention to this field, it is vital to know some of the problems catered to with BDA. Expanding knowledge of the data among the public sector practitioners plays a role in how BDA can reduce inefficiency and eventually increase revenue. Although the computational researchers have given increased attention to BDA using the public sector data ((Guenduez et al., 2020; Pencheva et al., 2020; Galetsi et al., 2020), developing the insights generated from these researches to management practices still needs to be thoroughly researched upon.

With the current study undertaken, we deploy a systematic literature review on the Emerging Management Disciplines (EMD) and applications in these EMDs that drive BDA usage. We deploy these theoretical yardsticks to guide the current study results since the former provides a solid foundation for future IS researchers to explore more BDA domains and applications. All relevant applications can be identified and evaluated using how much prior work has analyzed this domain to understand it better. Two primary research questions act as a guide to the current study:

**RQ1.** *What are the latest emerging management domains utilizing the capabilities of big data analytics.*

**RQ2.** *How these emerging management domains solve significant data analytics issues from a practical point of view.*

The rest of the manuscript is structured in the following sections: we start Section 2 with the research methodology taken to conduct the current study, followed by Section 3, representing the broader applications, and Section 4, discussing various applications in the management domains through core findings. Section 5 demonstrates the study's practical and managerial implications, and Section 6 summarizes in conclusion and briefly discusses future work scope.

## 2. Methodology

With some of the established methodologies (Snyder, 2019; Xiao & Watson, 2019) on literature review with over three hundred citations, we reviewed different stages. First, we developed a review protocol, followed by the control mechanisms with inclusion and exclusion criteria for domain relevancy and, finally, the findings' data extraction and synthesis. The following sections describe the steps followed to achieve the above, also represented in Fig. 1.

### 2.1. Protocol development

The first intuitive step in a systematic literature review is establishing a search protocol (Higgins et al., 2019). This protocol is a combination of keywords that are used to perform the data search. We have restricted our analysis only to Scopus as a database for the current study, and the article publishing date has been limited to the last ten years only. Next, with a few manual iterations, we identified the most prominent keywords best suited for the current study as "Big-Data" and "Big Data Analytics." Once the raw data has been identified and downloaded along with the publication source and author information, the next step is to identify the relevant articles to answer the current study's research questions.

### 2.2. Inclusion and exclusion criteria

To ensure that the data is downloaded for the systematic literature review, defining the inclusion and exclusion criteria is of utmost importance. We implied several inclusion and exclusion criteria to make the analysis and study focused. Research papers were included in the current study only if they provided an insight into how BDA has helped cater to management issues and problems. Research work before only 2011 was considered part of the analysis, as this was roughly the time since when

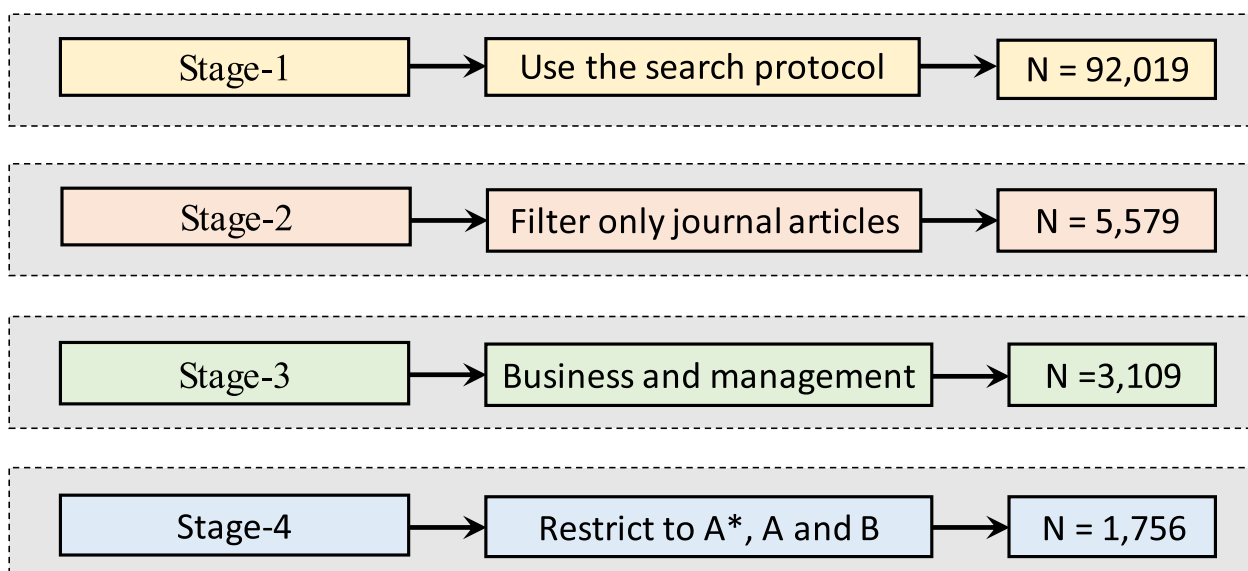


Fig. 1. Steps followed for the literature review.

the BDA started getting traction in solving real-world problems. The research articles published in outlets like journals targeting the broader research community were considered for the current analysis, and the conference proceedings were excluded for now. Any work published in non-English was also excluded for now from the present study. Only the research articles published in business and management journals were included in the current study.

### 2.3. Quality assessment

To ensure the current study's findings are based on the work well tested and established theoretical literature, we restricted the research articles downloaded only to Financial Times 50 listed journals; A\*, A, and B ranked journals as per Australian Business Dean's Council journal list or ranks of 4\*, 3 or 2 in Chartered Association of Business Schools journal ranking list. These research papers were also individually validated for several quality criteria: their scientific rigor, research methodology deployed, theoretical framework used from management studies, and finally, relevance. The relevance was further validated by looking at the titles of these articles. Eventually, the papers were manually dropped, which did not fit into the current study's scope.

### 3. Distribution and broader applications of BDA

To start this section, we first look at the distribution of the literature historically year-wise and then try to understand the broader management applications of BDA. For this, we have divided this section into two sub-sections.

#### 3.1. Distribution of the research work year-wise

The 1,756 research publications considered for the systematic literature review have been analyzed volume-wise per year to understand the increasing trend in publications represented in Fig. 2. Closely examining the trend of publication volume, there is a growing trend. There is also a massive jump in the numbers from 2018 till the current year 2020, with almost half of the total publications considered in the present study are in the last three years.

#### 3.2. Broader applications of BDA

Our prime motive is to understand how new management areas with the application of BDA emerge from the existing business function dis-

ciplined through the current research. We perform this at IS and management discourse using an inductive approach (Kar & Dwivedi, 2020), primarily used for theory building. We start with these articles' keywords and titles to analyze the BDA applications emerging management practices. Most of the text was already clean, with very little noise. Furthermore, we summarized these keywords using the topic modeling followed by understanding the surrounding applications of BDA using a network diagram of keywords keeping BDA (Berman and Katona, 2013b, Kar, 2015a, Aswani et al., 2017, Kushwaha et al., 2020, Kushwaha and Kar, 2020, Kushwaha et al., 2020, Mir et al., 2020) as the central theme. This network diagram is primarily a clustering of the author's keywords co-occurring with BDA and each other borrowing network sciences (Börner et al., 2007; Barabási, 2013) understanding. The networking exercise outcome is represented in Fig. 3 below, followed by the outcome of topic grouping from clustering in Fig. 4.

Closely analyzing the network diagram with BDA as the central theme, the surrounding clusters give us an idea of EMDs that witness applications' value. With simple manual interpretations and analysis of the network diagram, we identified 12 EMDs have been implementing BDA. These 10 EMDs are (1) Healthcare management, (2) Crisis management, (3) Governance management, (4) Smart manufacturing or industry 4.0, (5) Dynamic capabilities management, (6) Decision support systems, (7) Business models management, (8) Network management (primarily social media platform-oriented), (9) Services Management, (10) Search engine optimization (SEO), (11) Digital management, and (12) Financial management.

### 4. Core findings

To better uncover each of these EMDs, which is the primary objective of this study, we now divide the articles based on each of the 10 EMDs identified in the previous step and remove BDA as a keyword that will be the most common standard across all of these domains. We then run text summarization techniques like topic modeling (Llewellyn et al., 2015) and plot the word cloud outputs. Furthermore, we repeat the clustering and network plotting exercise to better learn BDA applications in each of these EMDs. In the following sub-section, let us discuss these EMDs one by one.

#### 4.1. Healthcare management

The second-largest EMD of BDA application that emerges from Fig. 3 is healthcare management. A detailed analysis of SEO articles is represented in Fig. 5. There are two aspects of the BDA research arti-

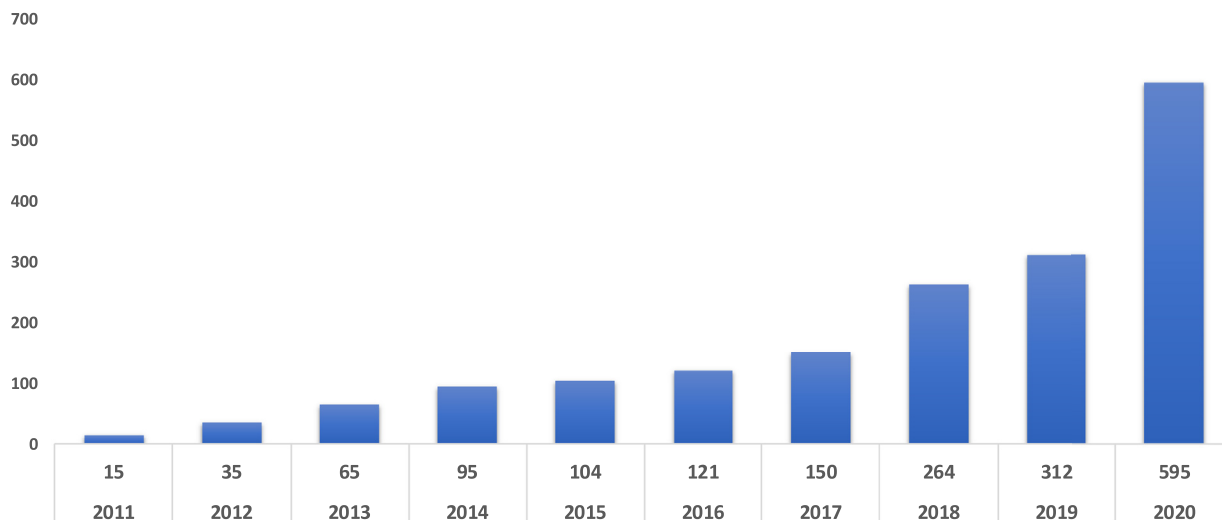


Fig. 2. Year-wise distribution of the research articles.

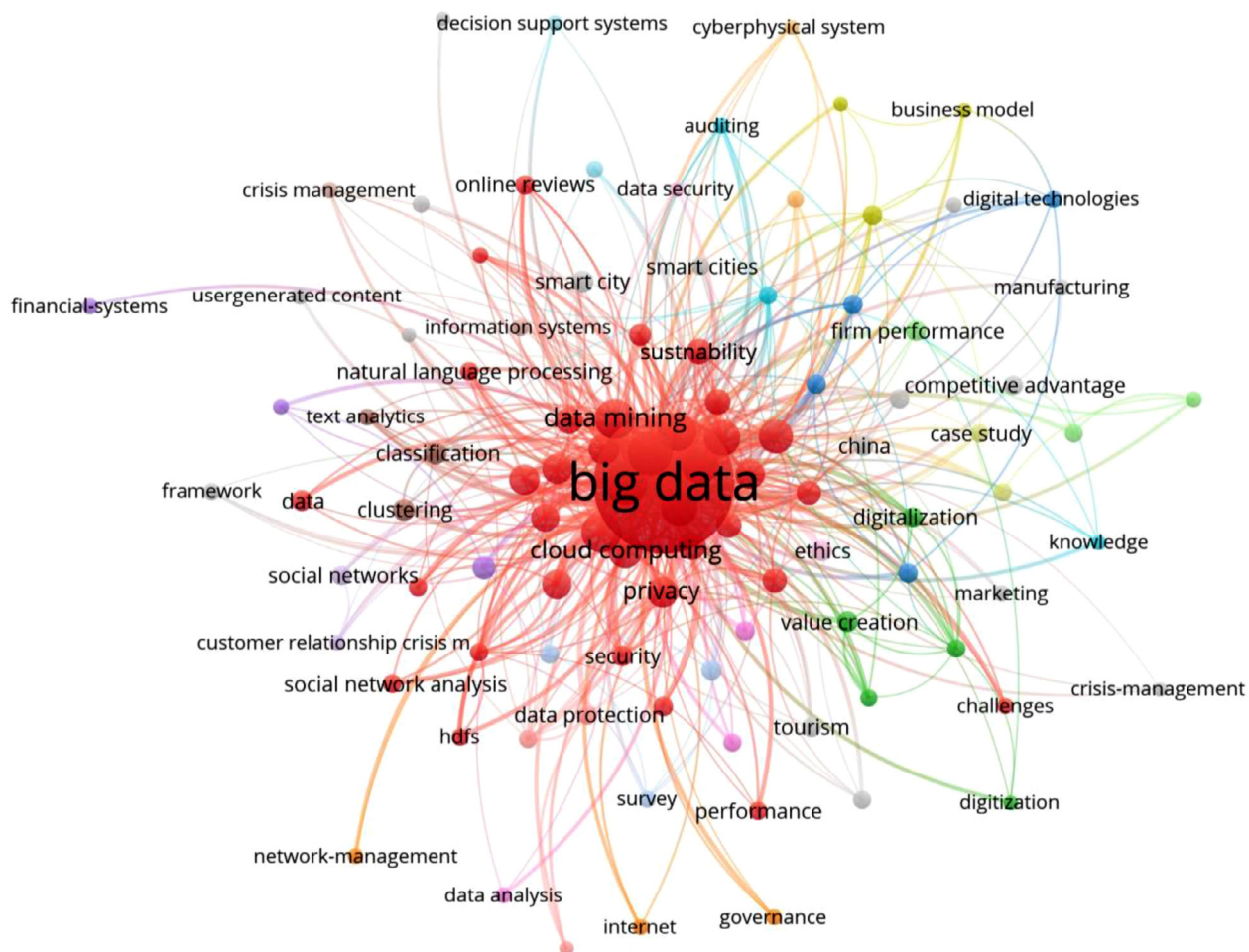


Fig. 3. Network diagram of broader applications of BDA

cles that emerge from the study. The first set of articles have researched upon the usage of the data generated through sensors (for instance: Fit-bit), through devices like scanners (eye, MRI), helping the doctors to address diseases like diabetic Mellitus, cardiovascular diseases, and more (Shilo et al., 2020; Cahan et al., 2019; Rumsfeld et al., 2016; Chaussabel & Pulendran, 2015). BDA has genuinely revolutionized the healthcare industry in the new age of data.

Interestingly, the second set of articles that establish health care management as an import EMD is the use of BDA to revolutionize the patients' consuming the data. This could be in the form of the healthcare chatbots (Price & Cohen, 2019; Galetsi et al., 2020) on a particular disease, or even the doctors are accessing the electronic healthcare records (Leightley et al., 2018) diagnosing the complex diseases quickly and making the prescription of the medicines quicker (Price & Cohen, 2019). Coupled with machine learning algorithms based on big data, healthcare has been truly revolutionized and hence is one of the EMDs of BDA.

#### 4.2. Crisis management

In the era of BDA, analysis is opening new possibilities for crisis management and communication. These crises could be due to natural disasters or even human-managed events disaster. Research articles considered in the current analysis have extensively discussed the use of timely and effective BDA insights in crisis management and preparation scenario (Hristidis et al., 2010; Zhang et al., 2012; Wang et al., 2016). A detailed analysis of crisis management articles is represented in Figure 6. The scientific community of crisis management's primary application is to understand and communicate the human crowd originated as an

interdisciplinary research field. Some of the prominent use cases are pandemic crisis communication management (Chen et al., 2020), evacuation during a natural disaster (Twarogowska et al., 2014), organizational crisis (Watson et al., 2017), and even disaster management (Akte & Wamba, 2019).

We have categorized these articles according to the four stages of crisis management. We noticed that about 36% of the articles address the first stage of crisis management, mitigation. These articles concisely discuss the various mitigation strategies that can be supported using BDA (Wang et al., 2016; Chang, 2015; Barton & Court, 2012), representing multiple hybrid decision support system applications through BDA. We found relatively fewer, only 22% of articles in the preparedness phase (Liaqat et al., 2017; Rovero & Ahumada, 2017; Carley et al., 2016). The response phase of crisis management had almost 30% of the articles (Ghosh & Gosavi, 2017; Kovács & Spens, 2007; Papadopoulos et al., 2017; Erdelj et al., 2017; Palmieri et al., 2016). The phase that needs future researchers' attention is disaster recovery, which had only two articles in the last ten years.

#### 4.3. Public administration and governance

The fourth exciting EMD that we analyzed with the current articles is public administration and governance (Mir, Kar, et al., 2020) using BDA. The first set of articles refer to information governance through BDA in the public and private sectors (Mikalef et al., 2020; Tallon, 2013). The second set of articles has researched healthcare data governance for the organizations working in this domain (Vayena & Blasimme, 2017; Tse et al., 2018). The third set of articles repre-



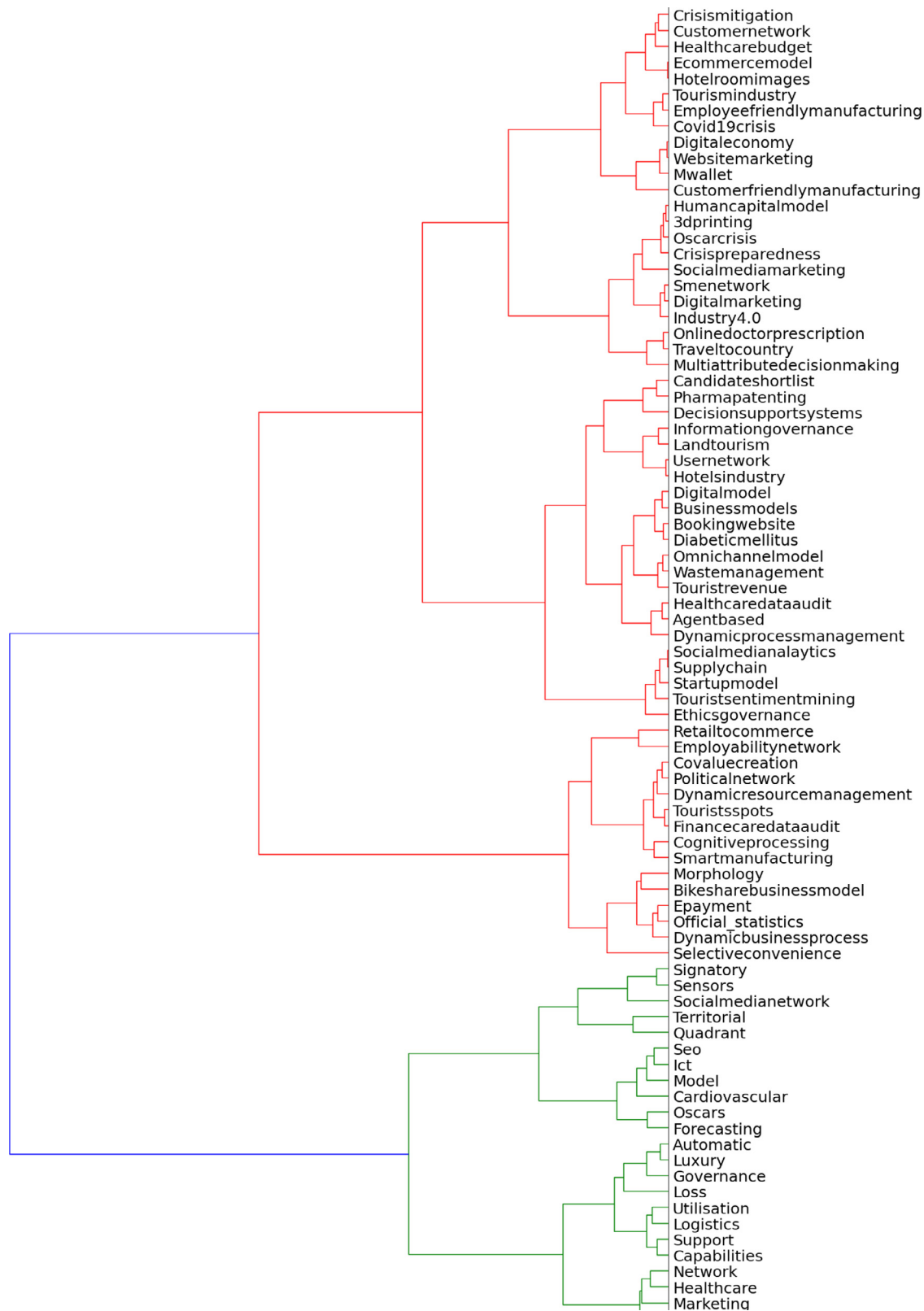


Fig. 4. Clustering of broader applications of BDA

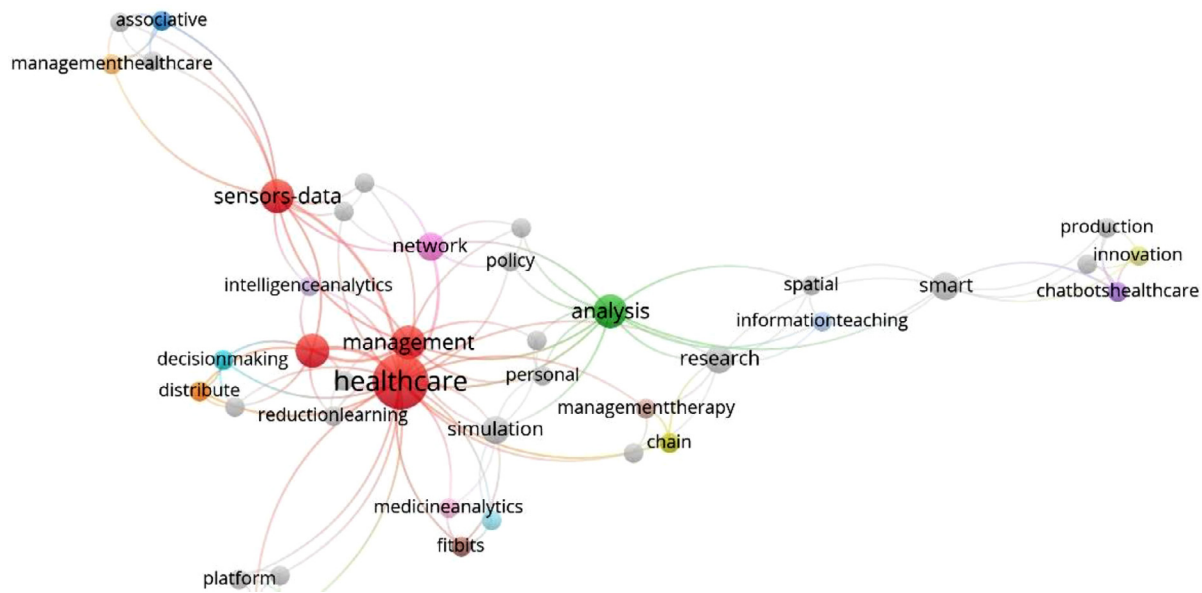


Fig. 5. Healthcare applications of BDA

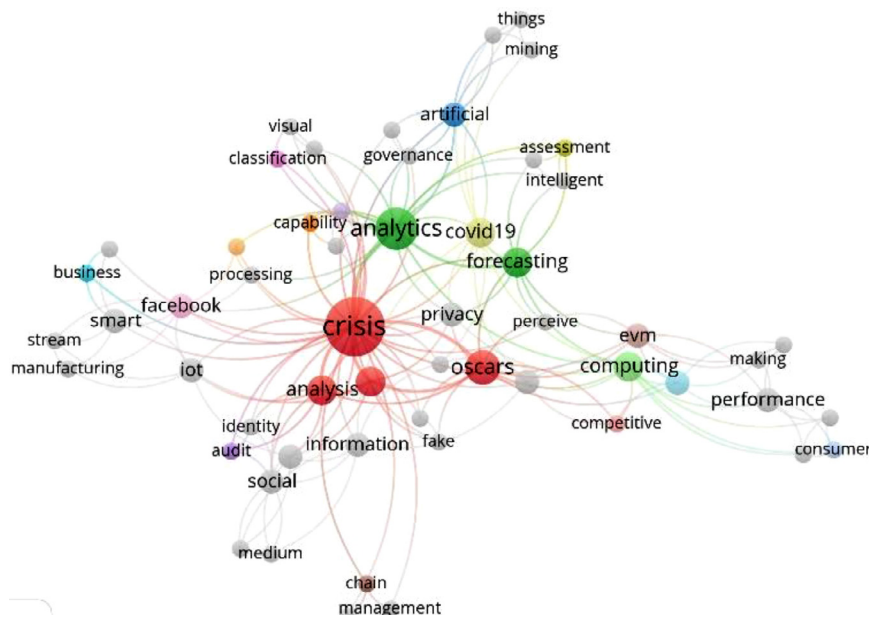


Fig. 6. Crisis management applications of BDA

sents the application of BDA in financial governance through algorithms (Campbell-Verduyn et al., 2017). A detailed analysis of public administration and governance articles is represented in Figure 7.

While most of the past work has been focusing on the governance of the firm performances in public, private, healthcare, and finance domains, focusing on the performance of each of these domains or synthesis of the literature also reveals that there exist very little research uncovering if and under what conditions BDA can help the firms in governance and also become more innovative.

#### 4.4. Industry 4.0 management

Manufacturing organizations embrace the convergence of the internet of things supported by cloud computing fueled by BDA. This makes the smart manufacturing industry the fifth emerging EMD consuming BDA. There are articles (Tao et al., 2018; Ren et al., 2019; Zheng et al., 2018) that hinge the value of BDA through information systems and device data to produce more smart equipment that is employee and

customer-friendly with the least production and inventory hold-up time. The focus has increased with the onset of Industry 4.0, where supply chain management, production management, and emerging technologies have a stable interaction with each other (Kar & Rakshit, 2015; Pani & Kar, 2011; Mir, Sharma, et al., 2020; Kar, 2015a). A detailed analysis of industry 4.0 management articles is represented in Figure 8.

Our investigation and the synthesis of the articles reveal how researchers have tied the BDA through looking at the user-generated content (UGC) from social media (SM) also combined with critical technologies for ubiquitous personalized services at all the product lifecycles of manufacturing (Zhang et al., 2020; Kusiak, 2017). Researchers (Tao et al., 2018) have also gone an extra mile to use BDA to come up with generic optimization techniques that can be labeled as stochastic programming and distributed programming (Shang & You, 2019), making these methods exclusively available for applications in systems operations and supply chain designs. There are also evident in the literature synthesized on 3D printing (Guha & Kumar, 2018), smart physical systems (Delicato et al., 2020) that are data-driven, moderniza-

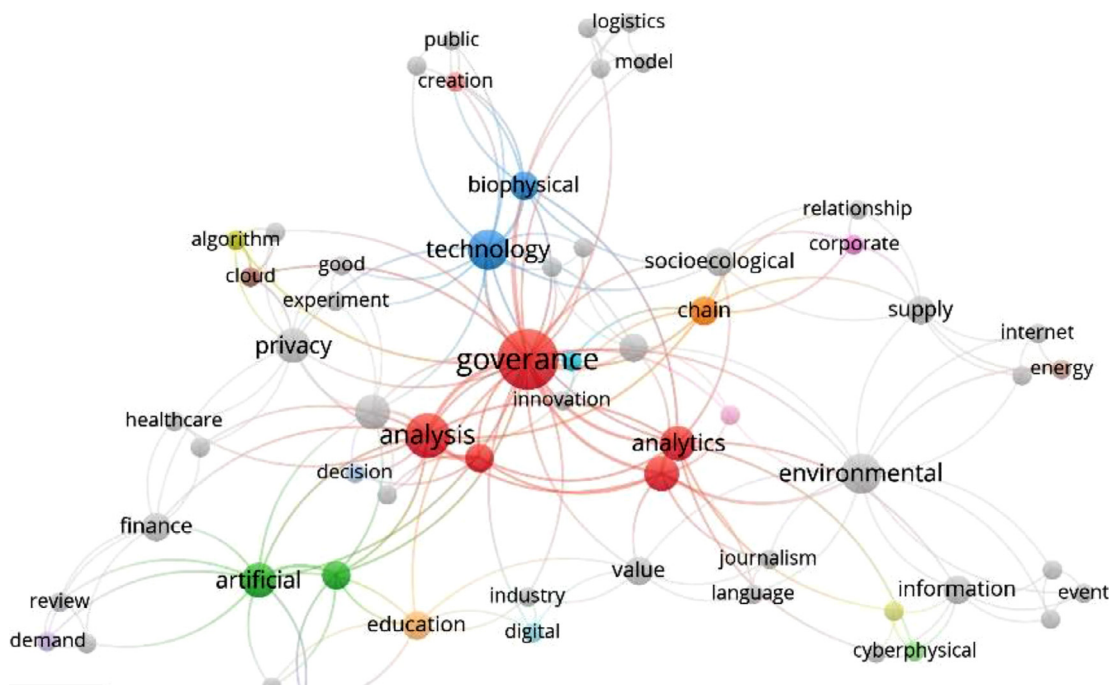


Fig. 7. Governance management applications of BDA

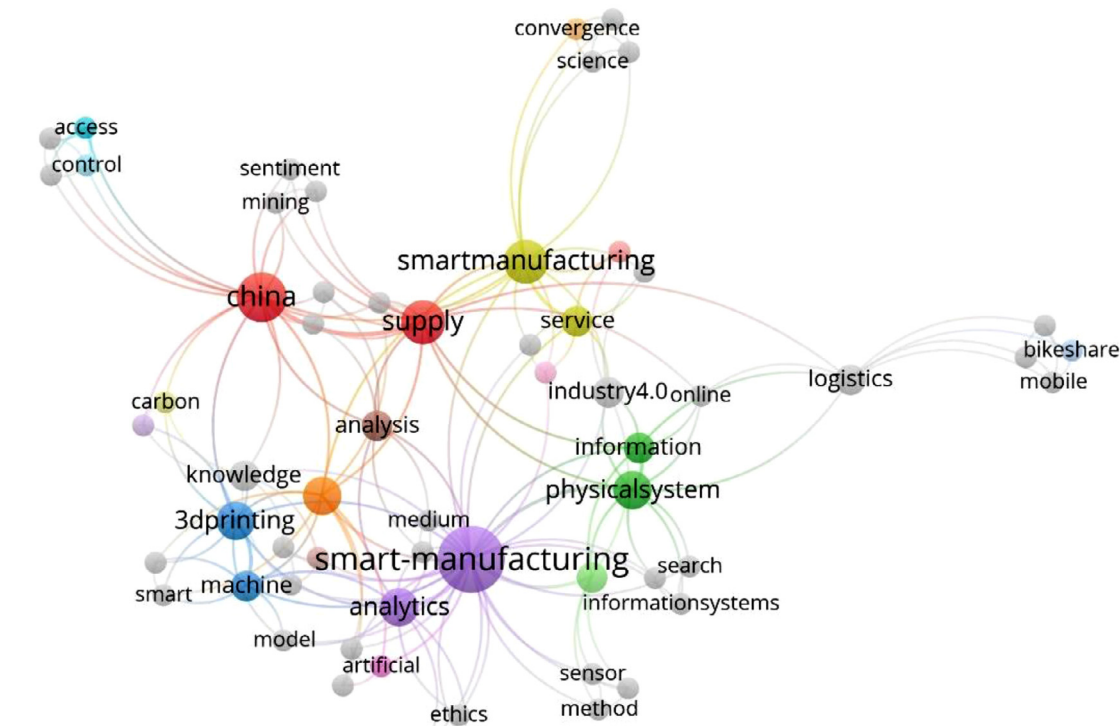


Fig. 8. Smart manufacturing applications of BDA

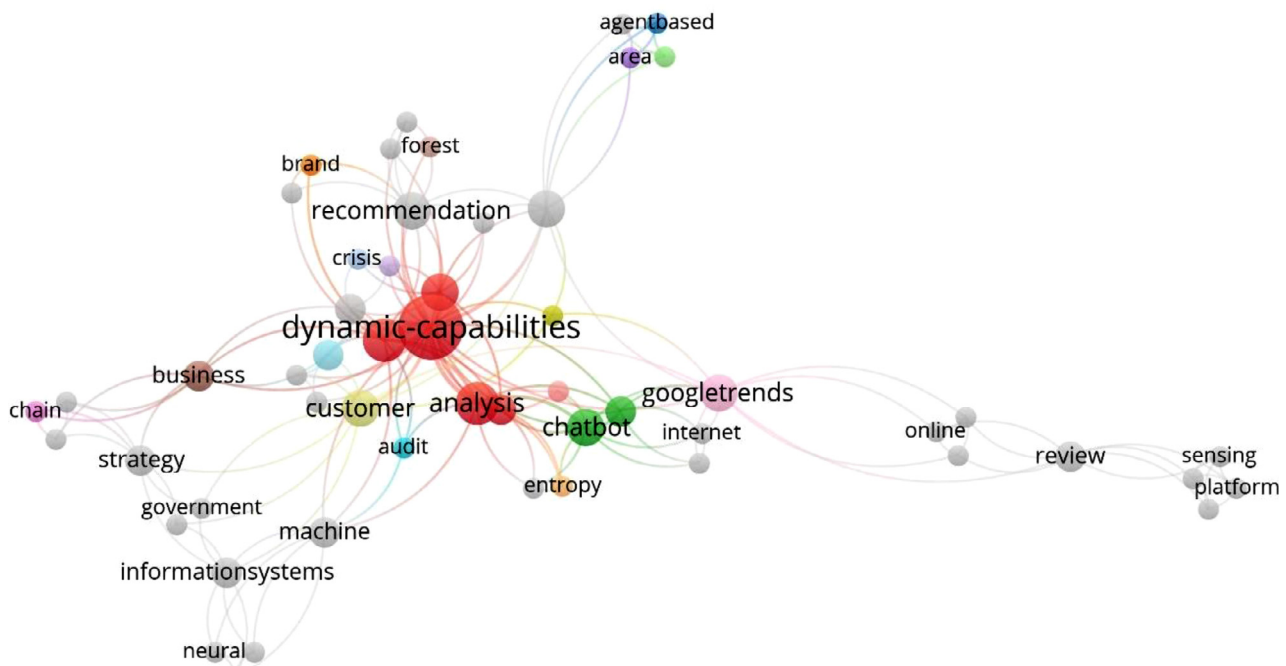
tion of logistics and supply, and finally the automation (Bag et al., 2020).

#### 4.5. Dynamic capabilities management

Providing valuable and dynamic business management capabilities is critical for the critical initiatives tested within significant data initiatives. There is popular literature supporting these artifacts from resource management (Braganza et al., 2017); process management

(Wamba et al., 2017); competitive edge during environmental turbulence (Akter et al., 2016), improving the accuracy of decision support systems to take a more accurate decision (Santoro et al., 2019), providing customized and tailored customer pricing (Erevelles et al., 2016) and overall improvement of organizational performance by providing dynamic business processes (Acharya et al., 2018). A detailed analysis of dynamic capabilities management articles is represented in Figure 9.

The synthesis of all the literature in this EMD makes us believe that BDA systems and capabilities have been researched and proved funda-



**Fig. 9.** Dynamic capabilities applications of BDA

mental to make management practitioners obtain dynamic data under BDA, get more dynamic information, and enable these managers to make the future course of the path more dynamic and customer friendly.

#### 4.6. Big data-driven decision making

One of the most prominent EMDs that has emerged with the current study is how decision support systems (DSS) use BDA's value to cater to real-time business issues. These DSSs ranges from maritime logistics (Lee et al., 2018) for monitoring vessel speed, human resources for candidate selection through multi-attribute decision making (Ijadi Maghsoodi et al., 2020), logistics delivery companies through dynamic vehicle routing (Sbai & Krichen, 2020), taking decisions on health care in smart cities using BDA (Clim et al., 2020), decision support systems in pharma patenting (Raghupathi et al., 2018), efficient allocation of healthcare budges as a decision support system (Tabari et al., 2019) to agriculture (Drohan et al., 2019). A detailed analysis of decision making articles is represented in Figure 10.

With the synthesis of the research work under this EMD, we report that volume of data is providing the bigger picture using BDA of an issue, which in turn is enabling the researchers and management practitioners in each of the domains listed in the prior paragraph to establish a DSS that can allow them to take any real-time or even retrospective learned decisions.

#### 4.7. Business models innovation

A business model is a framework for businesses to create value for customers from the marketplace while at the same time generating revenue and profit for themselves (Boons & Lüdeke-Freund, 2013). Innovations in these various types of business models (Sorescu et al., 2011) are increasingly becoming critical, and business heads are inclining more on data-driven decisions rather than experience-based decisions. From managing day-to-day issues for business houses and management practitioners, the BDA has also helped managers manage and build business models (Sarin et al., 2020; S. Kar et al., 2020). A detailed analysis of decision making articles is represented in Figure 11.

These models include digitization of business models (Loebbecke & Picot, 2015); also, at times upscaling the digital capabilities of an organization (Ritter & Pedersen, 2020), the co-value creation model (Kowalkowski et al., 2012); better status quo of the business model (Herbst et al., 2011), developing e-commerce business models for existing brick and mortar organization (Gregory et al., 2019), making the internal competitive environment as part of the organizational model (Grant, 2016), digitization of the logistic capabilities (Lai et al., 2010), omnichannel customer catering model (Z. W. Y. Lee et al., 2019) and finally models to harness natural human capital for an organization (Minbaeva, 2018).

#### 4.8. Multi-stakeholder networks

Effective network management of organizational resources as significant data initiatives is growing with importance among researchers. Our synthesis of articles as part of the current study revealed two sets of articles. The first set of articles refer to a new concept developed with the increase of the penetration of the internet over the last few years, referred to as connected devices with the appearance of smart devices (Karamitsos et al., 2019; Yang, 2019; Tsouri & Pegoretti, 2020; Dawadi et al., 2020). With the tremendous growth of data being recorded with each of these devices, connect over the internet can help organizations establish a network of customers' activities that could be spatial or temporal analysis (Doku & Rawat, 2019; Allam & Dhunny, 2019; Masoud et al., 2019). These new configurations of device connectivity through network management are entirely made possible due to BDA's value through IoT. A detailed analysis of decision making articles is represented in Figure 12.

The second set of articles talk about harnessing the social media network of individuals and small and medium enterprises (SMEs) to harness the behavioral understanding to cater better to them and better business sustainability (Sivarajah et al., 2020; Ghani et al., 2019; He et al., 2017). These social media networks are also used to understand individuals' socio-political aspects ranging from polarization from political entities (Grover et al., 2019; Kushwaha et al., 2020) to brand polarization (Osuna Ramírez et al., 2019; Wang et al., 2019).



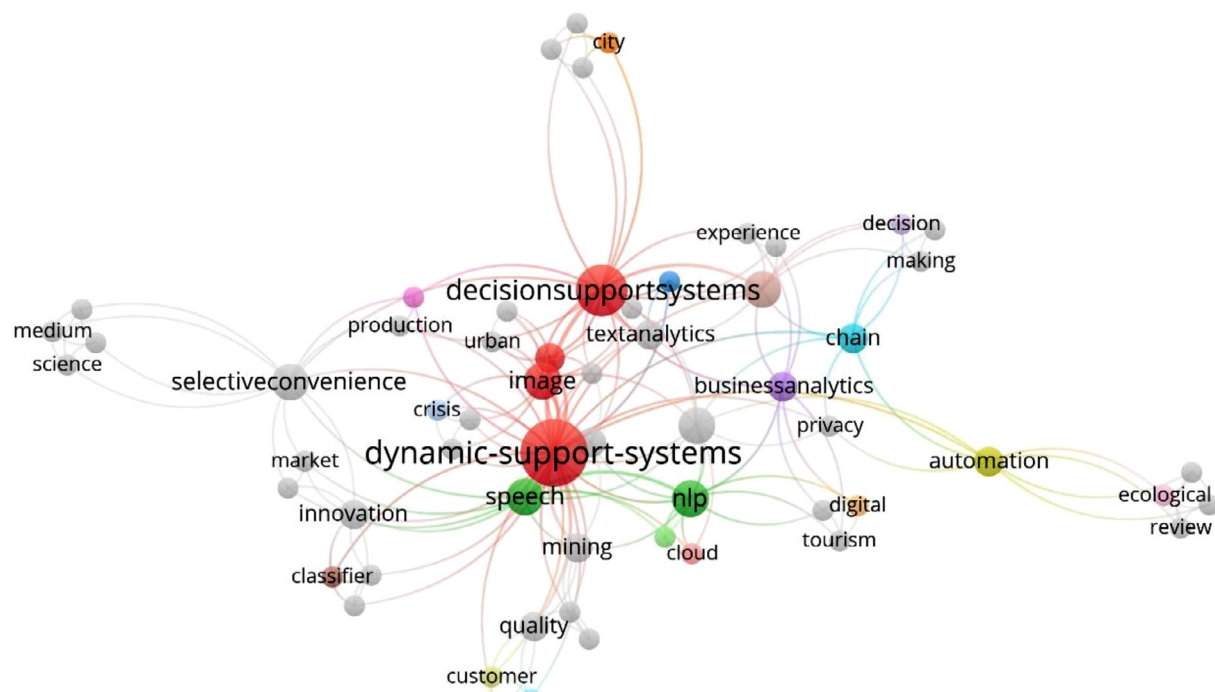


Fig. 10. DSS applications of BDA

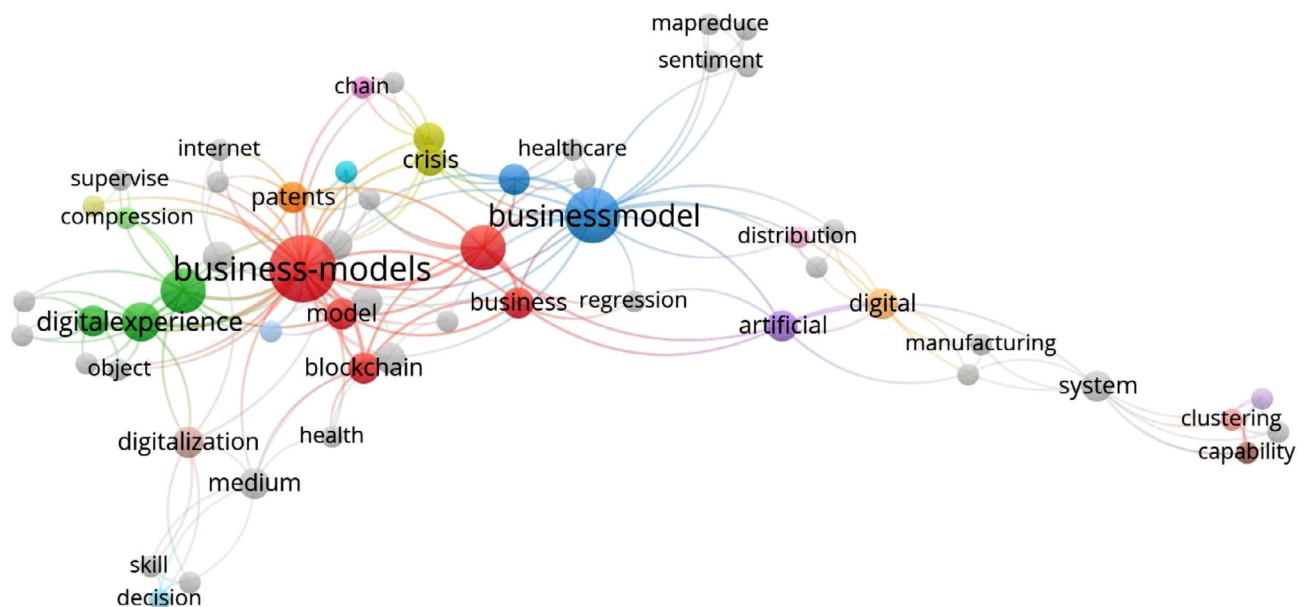


Fig. 11. Business models management applications of BDA

#### 4.9. Services management

Last and one of the exciting EMDs that has churned out from the current study of research articles is the services industry leveraging BDA to understand they cater to the customers better. One of the prominent vertical that sees the maximum consumption through BDA in recent times is the hospitality sector and, more specifically, the tourism industry (Kumar et al. 2020), where consumer research and experience are most crucial, has also been evolving rapidly with the internet's penetration (Phillips et al., 2017). This means that most tourist places are available over the internet through SMPs and online booking websites (Alaei et al., 2019). This also means that there is a large scale analysis of the tourists' sentiments (M. S. Hossain & Muhammad, 2019), checking

for the authenticity of information like the place, hotel room images (M. S. Hossain et al., 2018), opinion, and aspect mining of sites for better summarization (Wu et al., 2017) and finally towards decision making in the tourism domain (Ghasemaghaei & Turel, 2020). A detailed analysis of services management articles is represented in Figure 13.

As the horizons increase for travelers, there are research articles that are not only limited to local tourist spots or places but also help researchers to research beyond geographic limit globally with the vast volume of data available on the internet supported by BDA (Li et al., 2018; Kim et al., 2019; Xiang & Fesenmaier, 2017; Ma et al., 2020). Researchers have also suggested how BDA in the tourism industry has helped tourists stuck in the traveling countries to come back to their home countries with the travel restriction in pandemics like COVID19.

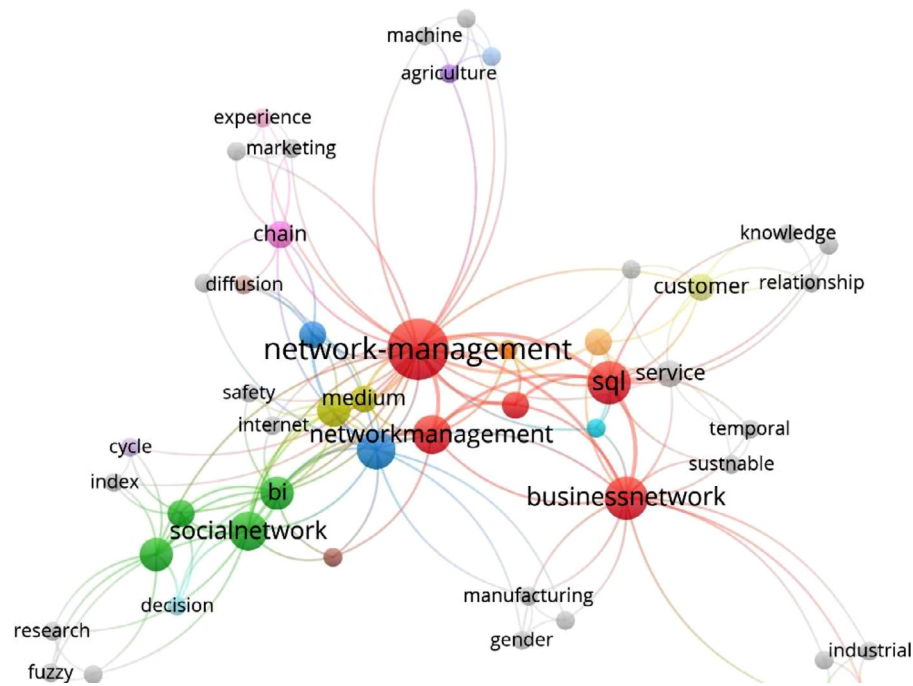


Fig. 12. Network management applications of BDA

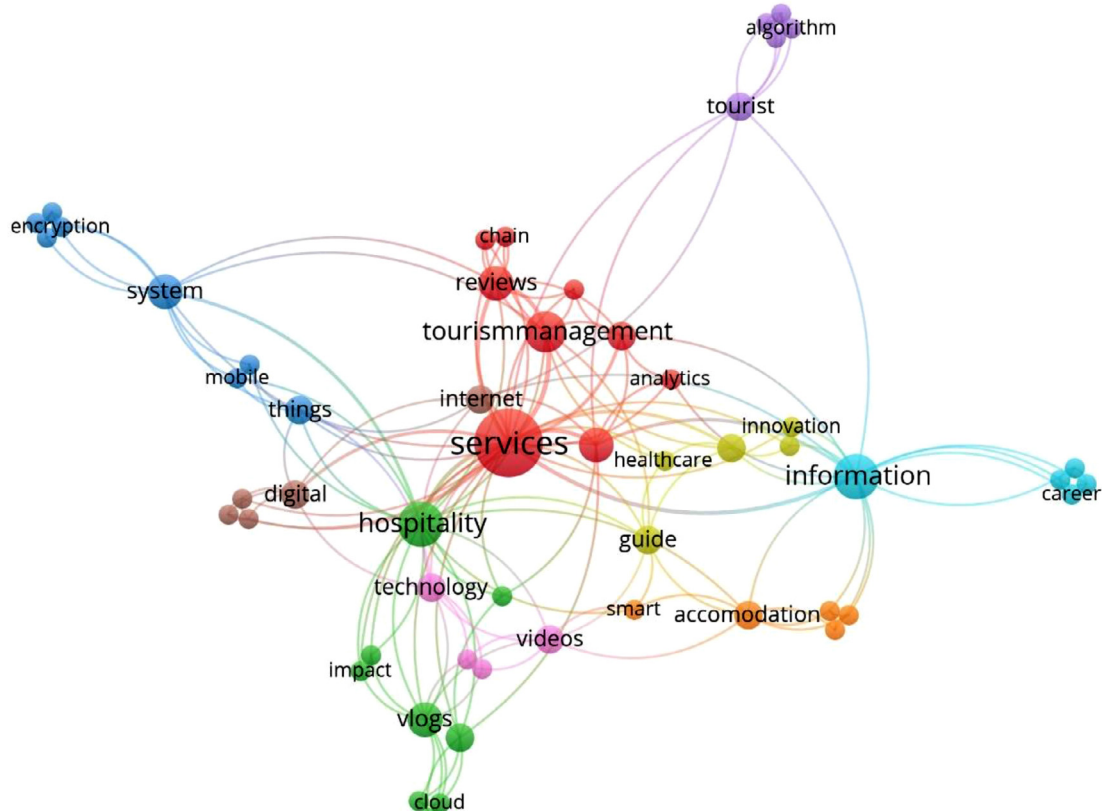


Fig. 13. Services management applications of BDA

#### 4.10. Digital marketing

An essential tool in search engine marketing (SEM) that plays a crucial role by improving the ranking of the website pages is done through search engine optimization (SEO) (Berman & Katona, 2013a). SEO is vital for business and digital managers to increase visibility among internet users searching for information (Killoran, 2013). One of the EMDs

that emerge from the analysis of Fig. 3 is SEO (Aswani, Kar, et al., 2017; A. K. Kar, 2015b; Aswani, Ghrera, et al., 2017). A detailed analysis of SEO articles is represented in Fig. 4. Scholars (Sen, 2005; Vieira et al., 2019) have been researching the role of SEO primarily in the marketing domain with the help of BDA. Digital marketing within SEO has seen exponential growth (Aswani et al., 2018) using BDA. Apart from SEO, social media analytics (SMA) has also been a significant consumer

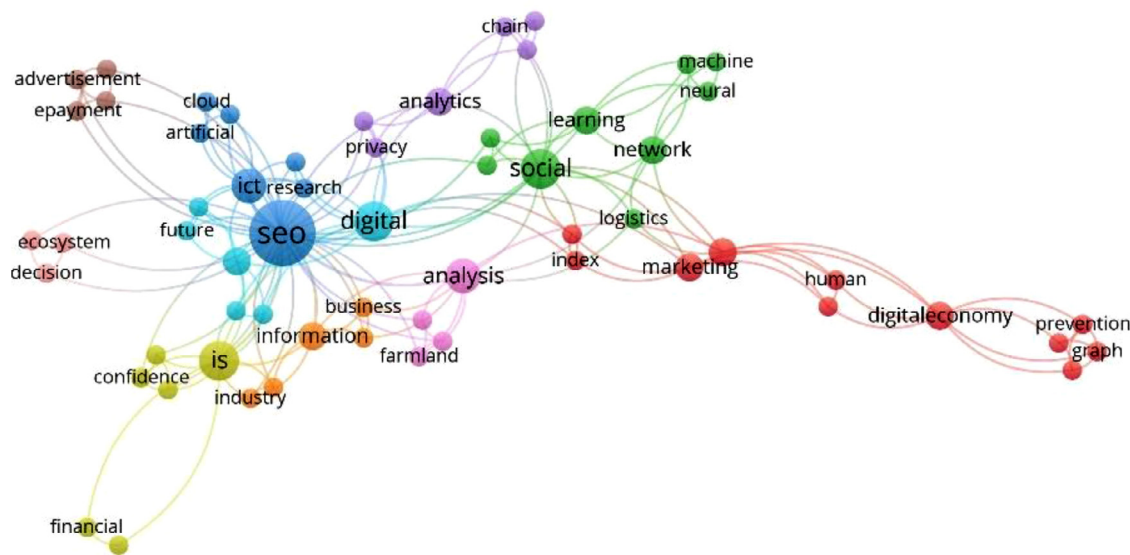


Fig. 14. SEO applications of BDA

of BDA when it comes to the IS domain within management (Grover & Kar, 2017; Kushwaha et al., 2020) to answer any questions ranging from understanding the political behavior polarization (Grover et al., 2019) to understanding them-wallet spending behavior (Grover et al., 2017a). These applications within IS had the right support of cognitive computing (S. Gupta et al., 2018) to ensure that the real value of BDA is reaped to make these applications possible. A detailed analysis of digital marketing articles is represented in Figure 14.

#### 4.11. Digital services management

With better and customized marketing, consumers in the recent time are getting more used to getting better offers, more customized digital services, and at times free promotional services in different verticals, which is primarily fueled by the digital and mobile application industry (Kar, 2020). In the past, a two-sided market mechanism driven advertisements have been used as a primary method used by the marketers to lure in the new customers. However, in the contemporary world, our analysis uncovers that big-data-driven new strategies are required to make the free-services model for the customers to sustain the long run to generate revenue. This is primarily driven by leveraging the sensors data (Grover et al., 2018) from various applications used by the customers on multiple devices and platforms to uncover the customers' accurate expectations and predict the correct usage using BDA. This EMD with the internet and mobile devices' penetration is called digital services management (DSM). A detailed analysis of digital services management articles is represented in Figure 15.

With increased digital transformation levels, the application of DSM is now not only limited to driving marketing and revenues, but it also leads to the application of BDA through digitization in the public domain for implementing various government digital policies (Mir, Kar, et al., 2020). This also involves learning the overall usage of various e-wallets and m-wallets (Grover et al., 2017b). Analyzing the right and correct user-sourced and user-generated big-data, both in the public and private domain, right eye-balls can be targeted with targeted and customized marketing and advertisement (Ghose & Han, 2014). Although big data continues to be the talk of the business town, many companies still struggle to unlock the value of DSM-generated big-data using BDA and fail to understand the suitable applications within the digital channel. This manuscript and findings will help the digital practitioners leverage BDA on DMS to gain the maximum insights.

#### 4.12. Financial services management

Financial services management (FSM) through big-data (Sun et al., 2019) is slowly becoming one of the prominent emerging management fields in overall governance and financial verticals. It is significantly changing both: prevailing business models of the companies working in the organizations' economic domain and financial models working in any domain outside the financial sector. A new research area evolving as FSM through quantitative methods and models supported by BDA has led management practitioners to practice FSM, which has also led it to grow as EMD. BDA has bridged the gap through econometric models for financial studies, research, and data science implementation. FSM also covers the analysis in some of the new applications (Grover et al., 2018). A detailed analysis of financial services management articles is represented in Figure 16.

Owing to the 4Vs characteristics of big-data, researchers in FSM have understood and researched in the private sector and some of the after-effect implications of implementing public policies in the public sectors (Mohan & Kar, 2017). BDA on FSM has helped both the government and private organizations to understand, read, and interpret the consumer or citizen signals and then perform the course corrections of the implementations accordingly.

## 5. Discussion

The synthesis and analysis of the research articles considered for the current study prove that despite all the hype that BDA has received in the last decade, researchers have demonstrated the real value in each of the ten EMDs that surfaced at the end of this study. With the undertaken systematic literature review in the current research, synthesizing the documents to date, we were able to establish ten prominent EMDs as (1) Healthcare management, (2) Crisis management, (3) Governance management, (4) Smart manufacturing or industry 4.0, (5) Dynamic capabilities management, (6) Decision support systems, (7) Business models management, (8) Network management (primarily social media platform-oriented), (9) Services Management, (10) Search engine optimization (SEO), (11) Digital management, and (12) Financial management. With further detailed analysis in each of these EMDs, we uncovered the places where BDA has been extensively used and under-researched areas in each of the EMDs, respectively. Post the individual assessment of each of the EMDs from an application perspective, and different BDA themes emerge from existing literature.

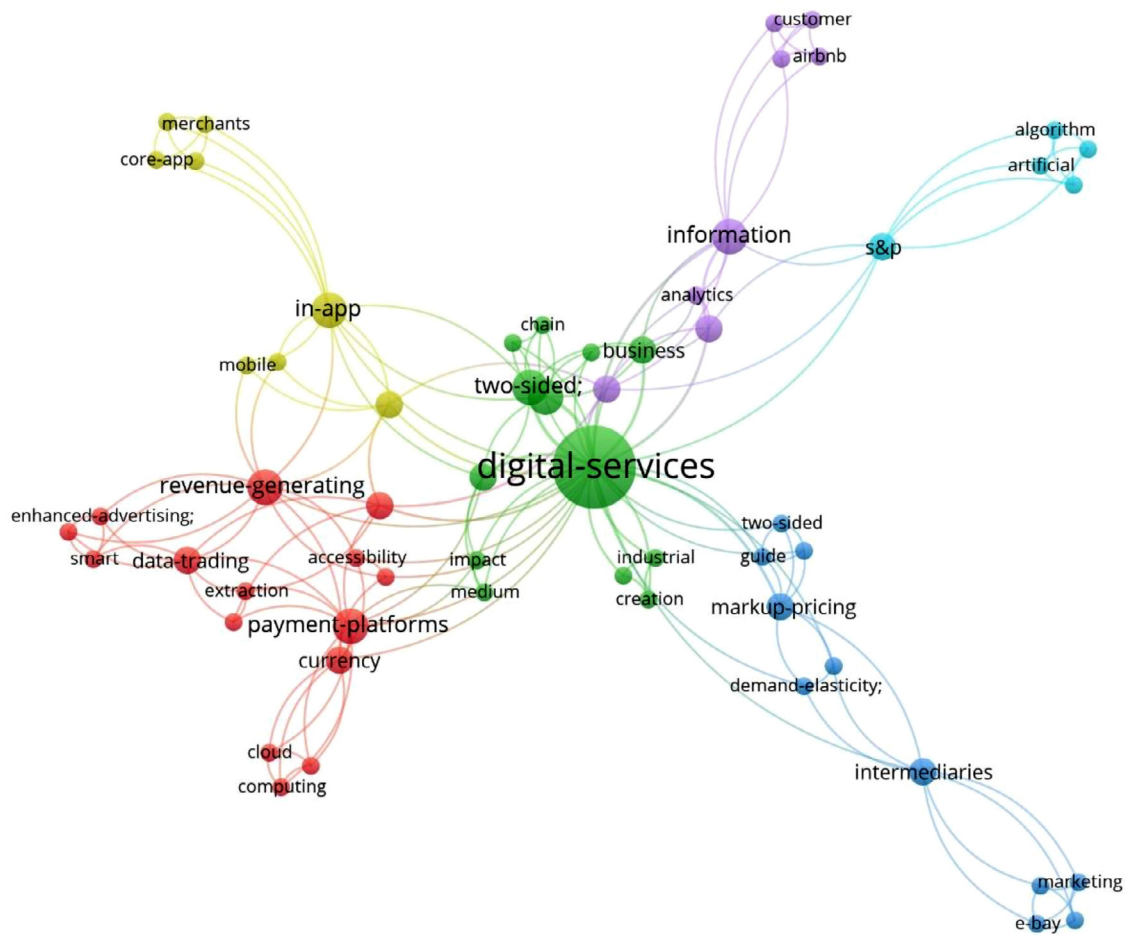


Fig. 15. DSM applications of BDA

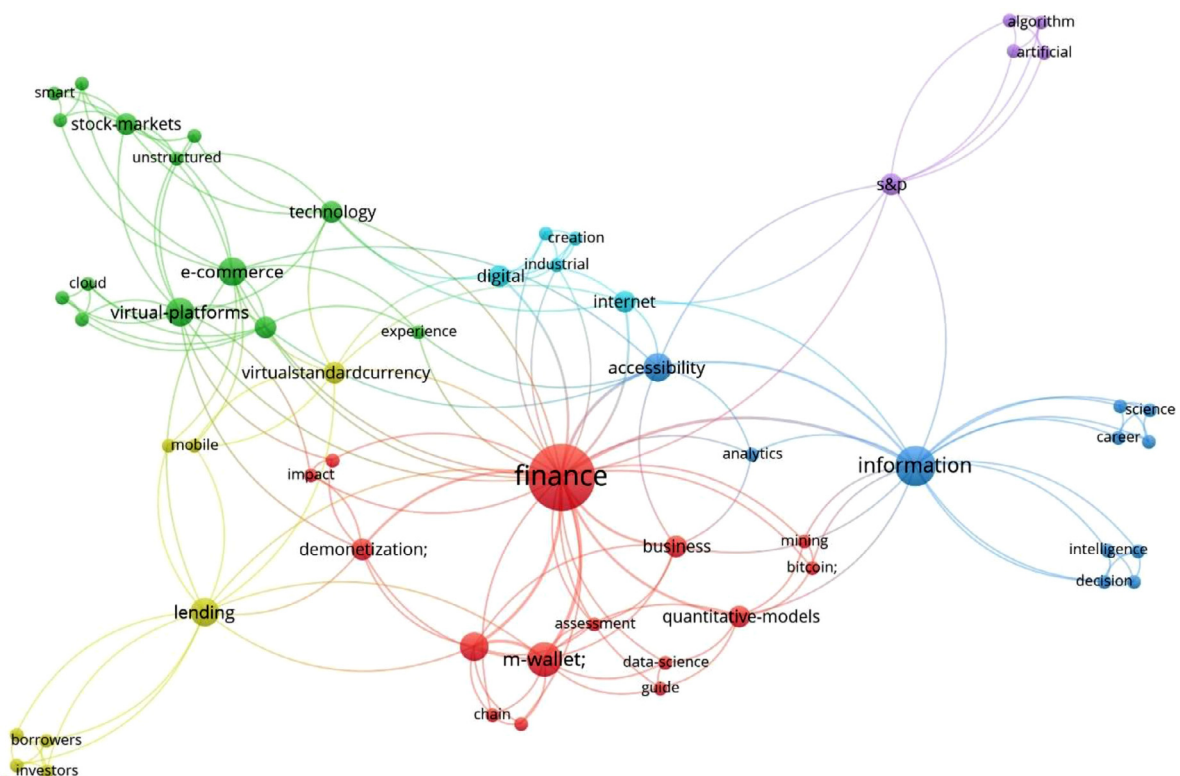


Fig. 16. FSM applications of BDA



### 5.1. Management practices mapped to EMD and directions for future research

Conventional management practices have been increasingly urged to improve how developed is used to make informed decisions. For a long, management practices being advocated include business sales, managing resources, developing strategic plans for various contingencies, and finally, the operations. These general management concepts and practices involved are not new for practitioners, but applying these concepts to unique aspects of IS area for problem-solving is enabled through the BDA capability of an organization, which eventually has led to more EMDs, which soon will become new management practices.

What is usually considered conventional management practice in the IS domain is now rapidly changing to EMDs, with more and more data is being recorded as each day goes by. An easy and rapid increase in the processing power has further made it possible to impact these EMDs in the business metrics reported significantly. However, before researchers deep dive into each of these EMDs, it is essential to understand how these EMDs map to conventional management practices; with the literature review done as part of the current analysis, we have mapped the twelve EMDs to the management practices, depending the actual application reported in each of these manuscripts. This mapping is represented in Figure 17.

The proposed mapping in the figure17 can be referred to as a potential framework for future IS researchers for taking future research problems. The applications fields of BDA are a fast emerging area with the help of informatics and processing tools to analyze, summarize, compute and generate insights. Referring to the proposed framework of EMDs mapped to management practices, also supported with the literature review taken in the current manuscript, there are still possibilities to perform and undertake research in the potential field of cluster5 EMDs in other management practices like human resources and even marketing and sales. The second research opportunity that future IS researchers can undertake is to analyze the EMDs in cluster2 to broader management practices like strategy and services.

### 5.2. Contribution to synthesized literature

#### 5.2.1. Theme 1: the orchestration of resources through BDA

While considerable work exists in building the dynamic capabilities and systems for an organization (Wamba et al., 2017; Akter et al., 2016) as building blocks of applicability of BDA, little known work exists on

how to perform the necessary orchestration of the resources to execute and develop these dynamic capabilities. Analysis of the prior literature makes us believe that with BDA driving DSSs of business organizations (Santoro et al., 2019; Erevelles et al., 2016), big data is a prerequisite building the capacity to build competitive advantage.

However, there exists little work on various stages of building these competencies in the contemporary business environment. Hence from both the EMDs dynamic capabilities and DSSs for business organizations, it is evident and significant to see the value additions done by BDA; however, the stage-wise resources and capability orchestration is one research field point future IS researchers to look into. Hence it is crucial for future IS researchers to examine the stage-wise capability-building process. Business organizations with similar resources will likely utilize varying BDA capabilities depending upon the process followed to reach there.

#### 5.2.2. Theme 2: disassociating BDA ability from the capability

Although it was clear from the synthesis of the prior literature in the current study that BDA capability could be measured from readiness in case of a crisis through various stages of crisis management scenarios (Y. Wang et al., 2016; L. Zhang et al., 2012; Hristidis et al., 2010) in case of a natural or human-managed event disaster. It also becomes an essential area of research on similar lines to look at the organization's capacity to utilize BDA towards real-time insights generation to cater to any crisis. Over a period, a business organization would have developed various capabilities to consume BDA towards specific operations like SEO (Berman & Katona, 2013; Sen, 2005). Firms might probably be utilizing BDA even to stay competitive.

Therefore, an assumption that BDA will improve an organization's operations might be slightly misleading and must be separately researched. Again, how the BDA is being consumed (for instance: through SMPs (Grover et al., 2019)) is an essential domain that future IS researchers can look into for future researches at scale.

#### 5.2.3. Theme 3: the rationality of BDA

The most important theme that has emerged from the current study and is consistent across all the EMDs is the rationale and motive behind adopting and relying on BDA. While BDA develops a more data-driven decision making capability across all the EMDs (H. Lee et al., 2018; Ren et al., 2019; X. Zhang et al., 2020; Ijadi Maghsoodi et al., 2020; Chaussabel & Pulendran, 2015) across healthcare, logistics, supply chain, and even human resource management, the types of insights

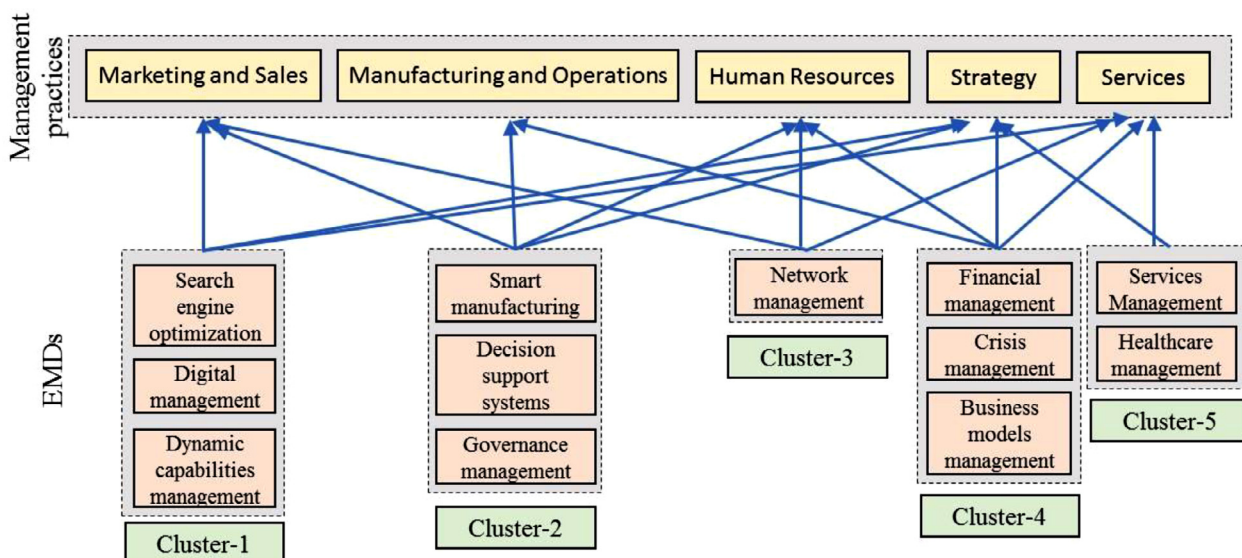


Fig. 17. Management practices and EMDs.

derived are bounded by variety and quality of the data available. The past research undertaken by IS scholars is well within the bounded rationality of BDA.

However, as a future avenue of research in BDA, IS scholars can establish a contextual correlation between the real rationale behind using the BDA by any business head or organization and the same contextual source used for building the big data. In minimal cases (Ransbotham & Kiron, 2017), it is seen that firms have participated in strategic alliances to make sure that organizations exchange big data on customers and market to build the capability. Hence one of the crucial constructs that can be tested in BDA is strategic alliances to source the data.

#### 5.2.4. Theme 4: business value measurement of BDA

One of the essential aspects of measuring the real value of BDA is to measure the incremental business value developed post adopting BDA. The value system and framework for determining the right measurement indicators to assess the value of BDA are prevalent in the research articles considered in the current study (M. Gupta & George, 2016; Rovero & Ahumada, 2017; Erevles et al., 2016). Similarly, the hype around BDA might bias management practitioners' decision to adopt BDA due to peer pressure, without knowing the right metrics to choose and measure if BDA will provide an incremental capability to their business. Therefore, the researchers of the articles considered in the current study identify critical business metrics that are normalized by various factors like the industry's current competitive landscape, overall adoption of BDA, the uncertainty of the market environment, and the number of overall competitors in the domain. With that and the study's current findings, we also encourage future IS researchers to develop further subjective and quantitative measures to better define these metrics.

#### 5.2.5. Theme 5: turning insights of BDA into a real-time actionable item

To ensure that the businesses realize the real value of BDA, the energy and resources must focus on collecting big data and generating insights, but it is also crucial to ensure that these insights are implemented on a real-time basis. The research articles analyzed in the current study (Palmieri et al., 2016; Sbai & Krichen, 2020; Ghosh & Gosavi, 2017) have reported through various mechanisms on how BDA can be well converted to actionable items to make sure that the insights are well implemented for a business to harness the value from the investment in BDA.

Some of these mechanisms reported in the research articles are: through cloud environment and architecture (Palmieri et al., 2016), smart devices connected through the internet (Clim et al., 2020), also an essential application in smart-cities (A. K. Kar et al., 2019; Chauhan et al., 2016), sensors under various scenarios (Masoud et al., 2019), and self-decision making algorithmic driven chatbots (Kushwaha & Kar, 2020) are the prominent ones. Hence, researchers make a well-established claim and contribution through these researches that the real value of BDA is not limited to collecting and generating the insights phase but is also essential to ensure that these insights are well implemented until the last mile.

#### 5.3. Managerial implications

One specific factor that has emerged among all the research articles in the current study is the amount of trust or distrust in the overall business value and quantitative accuracy that BDA outputs bring in. While operations-line managers might be highly interested and motivated to invest and build BDA capability (Akter et al., 2016; Mikalef et al., 2019), the executive level business heads might be interested in decision-making feel more confident in taking intuitive based decisions rather than BDA output based.

This process has been well researched through the dual lens of BDA as a capability and organization sciences domain (Hodgkinson & Healey, 2011). The basic premise of the research in the above-quoted

work is that the manager's decision by motivated by the cognitive responses from BDA might be over-ridden by an executive gap in trust on BDA, which reduces the real value of BDA. Hence the current study undertaken with the research articles present in the analysis provides managers a comprehensive and synthesized view into how this gap can be filled with the success case studies across all the EMDs and the issues catered within each of these EMDs followed by the framework to measure the real value of the BDA.

#### 6. Conclusion

An ever-increasing number of companies attempt to adopt BDA to use the data's hidden trends and signals and help decision managers aid data-driven decisions. While these companies must utilize the real value of BDA, it is also equally crucial for them to understand the learnings from the successful use-cases, success criteria, and the right metrics to measure real incremental business value. Hence, the current manuscript and the findings reported as EMDs as an outcome of the study undertaken will act as a reference for future IS scholars and become an essential note for management practitioners to learn from the issues catered by BDA in each of these domains. With BDA yet to be commoditized like IT products, some research needs to be done on managing resources and implementation phases of BDA. While the earlier research articles analyzed in the current study have well reported how BDA have helped various real-time and looking at the issue retrospectively, there is a lack of theoretically driven research identifying how these BDA solutions can be well implemented to gain business and competitive advantage.

To this end, the current study has analyzed various business value measuring frameworks that can measure a real unbiased value of BDA and concepts from operations and crisis management perspective. The synthesis of the prior research work in the current study acts as a reference for broader implementation of BDA to become a commodity for business houses, which will allow business organizations to get higher returns on investments. While the ten EMDs reported in the current study could be at an abstract higher level, but hopefully, the insights from the current manuscript can guide future scholars to perform in-depth research in each of these EMDs individually, which will make the business heads see each of these as full-grown management practices (Figs. 1–17)

#### References

- Acharya, A., Singh, S. K., Pereira, V., & Singh, P. (2018). Big data, knowledge co-creation and decision making in fashion industry. *International Journal of Information Management*, 42, 90–101. [10.1016/j.ijinfomgt.2018.06.008](https://doi.org/10.1016/j.ijinfomgt.2018.06.008).
- Akter, S., & Wamba, S. F. (2019). Big data and disaster management: A systematic review and agenda for future research. *Annals of Operations Research*, 283(1), 939–959. [10.1007/s10479-017-2584-2](https://doi.org/10.1007/s10479-017-2584-2).
- Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R., & Childe, S. J. (2016). How to improve firm performance using big data analytics capability and business strategy alignment? *International Journal of Production Economics*, 182, 113–131. [10.1016/j.ijpe.2016.08.018](https://doi.org/10.1016/j.ijpe.2016.08.018).
- Alaei, A. R., Becken, S., & Stantic, B. (2019). Sentiment analysis in tourism: Capitalizing on big data. *Journal of Travel Research*, 58(2), 175–191. [10.1177/0047287517747753](https://doi.org/10.1177/0047287517747753).
- Allam, Z., & Dhunny, Z. A. (2019). On big data, artificial intelligence and smart cities. *Cities*, 89, 80–91. [10.1016/j.cities.2019.01.032](https://doi.org/10.1016/j.cities.2019.01.032).
- Aswani, R., Gherra, S. P., Kar, A. K., & Chandra, S. (2017). Identifying buzz in social media: A hybrid approach using artificial bee colony and k-nearest neighbors for outlier detection. *Social Network Analysis and Mining*, 7(1), 38. [10.1007/s13278-017-0461-2](https://doi.org/10.1007/s13278-017-0461-2).
- Aswani, R., Kar, A. K., Aggarwal, S., & Vigneswara Ilavarasan, P. (2017). Exploring content virality in facebook: A semantic based approach. In A. K. Kar, P. V. Ilavarasan, M. P. Gupta, Y. K. Dwivedi, M. Mäntymäki, M. Janssen, A. Simintiras, & S. Al-Sharhan (Eds.), *Digital Nations – Smart Cities, Innovation, and Sustainability* (pp. 209–220). Springer International Publishing. [10.1007/978-3-319-68557-1\\_19](https://doi.org/10.1007/978-3-319-68557-1_19).
- Aswani, R., Kar, A. K., Ilavarasan, P. V., & Dwivedi, Y. K. (2018). Search engine marketing is not all gold: Insights from Twitter and SEOClerks. *International Journal of Information Management*, 38(1), 107–116. [10.1016/j.ijinfomgt.2017.07.005](https://doi.org/10.1016/j.ijinfomgt.2017.07.005).
- Bag, S., Gupta, S., & Wood, L. (2020). Big data analytics in sustainable humanitarian supply chain: Barriers and their interactions. *Annals of Operations Research*. [10.1007/s10479-020-03790-7](https://doi.org/10.1007/s10479-020-03790-7).
- Barabási, A. L. (2013). Network science. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 371 20120375.
- Barton, D., & Court, D. (2012). Making advanced analytics work for you. *Harvard Business Review*, 90, 78.

- Berman, R., & Katona, Z. (2013a). The role of search engine optimization in search marketing. *Marketing Science*, 32(4), 644–651. [10.1287/mksc.2013.0783](#).
- Berman, R., & Katona, Z. (2013b). The role of search engine optimization in search marketing. *Marketing Science*, 32(4), 644–651. [10.1287/mksc.2013.0783](#).
- Boons, F., & Lüdtke-Freund, F. (2013). Business models for sustainable innovation: State-of-the-art and steps towards a research agenda. *Journal of Cleaner Production*, 45, 9–19. [10.1016/j.jclepro.2012.07.007](#).
- Börner, K., Sanyal, S., & Vespignani, A. (2007). Network science. *Annual Review of Information Science and Technology*, 41(No. 1), 537–607.
- Braganza, A., Brooks, L., Nepelski, D., Ali, M., & Moro, R. (2017). Resource management in big data initiatives: Processes and dynamic capabilities. *Journal of Business Research*, 70, 328–337. [10.1016/j.jbusres.2016.08.006](#).
- Cahan, E. M., Hernandez-Boussard, T., Thadaney-Israni, S., & Rubin, D. L. (2019). Putting the data before the algorithm in big data addressing personalized healthcare. *Npj Digital Medicine*, 2(1), 1–6. [10.1038/s41746-019-0157-2](#).
- Campbell-Verduyn, M., Goguen, M., & Porter, T. (2017). Big Data and algorithmic governance: The case of financial practices. *New Political Economy*, 22(2), 219–236. [10.1080/13563467.2016.1216533](#).
- Carley, K. M., Malik, M., Landwehr, P. M., Pfeffer, J., & Kowalchuck, M. (2016). Crowd sourcing disaster management: The complex nature of Twitter usage in Padang Indonesia. *Safety Science*, 90, 48–61. [10.1016/j.ssci.2016.04.002](#).
- Chang, V. (2015). Towards a big data system disaster recovery in a private cloud. *Ad Hoc Networks*, 35, 65–82. [10.1016/j.adhoc.2015.07.012](#).
- Chauhan, S., Agarwal, N., & Kar, A. K. (2016). Addressing big data challenges in smart cities: A systematic literature review. *Info*, 18(4), 73–90. [10.1108/info-03-2016-0012](#).
- Chaussabel, D., & Pulendran, B. (2015). A vision and a prescription for big data-enabled medicine. *Nature Immunology*, 16(5), 435–439. [10.1038/ni.3151](#).
- Chen, C.-M., Jyan, H.-W., Chien, S.-C., Jen, H.-H., Hsu, C.-Y., Lee, P.-C., Lee, C.-F., Yang, Y.-T., Chen, M.-Y., Chen, L.-S., Chen, H.-H., & Chan, C.-C. (2020). Containing COVID-19 among 627,386 persons in contact with the diamond princess cruise ship passengers who disembarked in Taiwan: Big Data analytics. *Journal of Medical Internet Research*, 22(5), e19540. [10.2196/19540](#).
- Clim, A., Zota, R., Constantinescu, R., & Ilie-Nemedi, I. (2020). Health services in smart cities: Choosing the big data mining based decision support. *International Journal of Healthcare Management*, 13(1), 79–87. [10.1080/20479700.2019.1650478](#).
- Constantiou, I. D., & Kallinikos, J. (2015). New games, new rules: Big data and the changing context of strategy. *Journal of Information Technology*, 30(1), 44–57. [10.1057/jit.2014.17](#).
- Dawadi, B. R., Rawat, D. B., Joshi, S. R., & Keitsch, M. M. (2020). Towards energy efficiency and green network infrastructure deployment in Nepal using software defined IPv6 network paradigm. *The Electronic Journal of Information Systems in Developing Countries*, 86(1), e12114. [10.1002/isd2.12114](#).
- Delicato, F. C., Al-Anbuky, A., & Wang, K. I.-K. (2020). Editorial: Smart cyber-physical systems: Toward pervasive intelligence systems. *Future Generation Computer Systems*, 107, 1134–1139. [10.1016/j.future.2019.06.031](#).
- Doku, R., & Rawat, D. B. (2019). Big Data in Cybersecurity for Smart City Applications. In D. B. Rawat, & K. Z. Ghafoor (Eds.), *Smart Cities Cybersecurity and Privacy* (pp. 103–112). Elsevier. [10.1016/B978-0-12-815032-0.00008-1](#).
- Drohan, P. J., Bechmann, M., Buda, A., Djodjic, F., Doody, D., Duncan, J. M., Iho, A., Jordan, P., Kleinman, P. J., McDowell, R., Mellander, P.-E., Thomas, I. A., & Withers, P. J. A. (2019). A global perspective on phosphorus management decision support in agriculture: Lessons learned and future directions. *Journal of Environmental Quality*, 48(5), 1218–1233. [10.2134/jeq2019.03.0107](#).
- Erdelj, M., Natalizio, E., Chowdhury, K. R., & Akylidiz, I. F. (2017). Help from the sky: Leveraging UAVs for disaster management. *IEEE Pervasive Computing*, 16(1), 24–32. [10.1109/MPRV.2017.11](#).
- Erevelles, S., Fukawa, N., & Swayne, L. (2016). Big Data consumer analytics and the transformation of marketing. *Journal of Business Research*, 69(2), 897–904. [10.1016/j.jbusres.2015.07.001](#).
- Galetsis, P., Katsaliaki, K., & Kumar, S. (2020). Big data analytics in health sector: Theoretical framework, techniques and prospects. *International Journal of Information Management*, 50, 206–216. [10.1016/j.ijinfomgt.2019.05.003](#).
- Ghani, N. A., Hamid, S., Targio Hashem, I. A., & Ahmed, E. (2019). Social media big data analytics: A survey. *Computers in Human Behavior*, 101, 417–428. [10.1016/j.chb.2018.08.039](#).
- Ghasemaghaei, M., & Turel, O. (2020). Possible negative effects of big data on decision quality in firms: The role of knowledge hiding behaviours. *Information Systems Journal*, n/a(n/a). [10.1111/isj.12310](#).
- Ghose, A., & Han, S. P. (2014). Estimating demand for mobile applications in the new economy. *Management Science*, 60(6), 1470–1488. [10.1287/mnsc.2014.1945](#).
- Ghosh, S., & Gosavi, A. (2017). A semi-Markov model for post-earthquake emergency response in a smart city. *Control Theory and Technology*, 1(15), 13–25.
- Grant, R. M. (2016). Prospering in dynamically-competitive environments: organizational capability as knowledge integration. *Organization Science*, 7(4), 375–387. [10.1287/orsc.7.4.375](#).
- Gregory, G. D., Ngo, L. V., & Karavdic, M. (2019). Developing e-commerce marketing capabilities and efficiencies for enhanced performance in business-to-business export ventures. *Industrial Marketing Management*, 78, 146–157. [https://doi.org/10.1016/j.indmarman.2017.03.002](#)
- Grover, P., & Kar, A. K. (2017). Big data analytics: A review on theoretical contributions and tools used in literature. *Global Journal of Flexible Systems Management*, 18(3), 203–229. [10.1007/s40171-017-0159-3](#).
- Grover, P., Kar, A. K., Dwivedi, Y. K., & Janssen, M. (2019). Polarization and acculturation in US Election 2016 outcomes – Can twitter analytics predict changes in voting preferences. *Technological Forecasting and Social Change*, 145, 438–460. [10.1016/j.techfore.2018.09.009](#).
- Grover, P., Kar, A. K., & Ilavarasan, P. V. (2017a). Understanding nature of social media usage by mobile wallets service providers – An exploration through SPIN framework. *Procedia Computer Science*, 122, 292–299. [10.1016/j.procs.2017.11.372](#).
- Grover, P., Kar, A. K., & Ilavarasan, P. V. (2017b). Understanding nature of social media usage by mobile wallets service providers – An exploration through SPIN framework. *Procedia Computer Science*, 122, 292–299. [10.1016/j.procs.2017.11.372](#).
- Grover, P., Kar, A. K., & Vigneswara Ilavarasan, P. (2018). Blockchain for businesses: A systematic literature review. In S. A. Al-Sharhan, A. C. Simintiras, Y. K. Dwivedi, M. Janssen, M. Mäntymäki, L. Tahat, I. Moughrabi, T. M. Ali, & N. P. Rana (Eds.), *Challenges and Opportunities in the Digital Era* (pp. 325–336). Springer International Publishing. [10.1007/978-3-030-02131-3\\_29](#).
- Guenduez, A. A., Mettler, T., & Schedler, K. (2020). Technological frames in public administration: What do public managers think of big data? *Government Information Quarterly*, 37(1), Article 101406. [10.1016/j.giq.2019.101406](#).
- Guha, S., & Kumar, S. (2018). Emergence of big data research in operations management, information systems, and healthcare: Past contributions and future roadmap. *Production and Operations Management*, 27(9), 1724–1735. [10.1111/poms.12833](#).
- Gupta, M., & George, J. F. (2016). Toward the development of a big data analytics capability. *Information & Management*, 53(8), 1049–1064. [10.1016/j.im.2016.07.004](#).
- Gupta, S., Kar, A. K., Baabdullah, A., & Al-Khowaiter, W. A. A. (2018). Big data with cognitive computing: A review for the future. *International Journal of Information Management*, 42, 78–89. [10.1016/j.ijinfomgt.2018.06.005](#).
- He, W., Wang, F.-K., & Akula, V. (2017). Managing extracted knowledge from big social media data for business decision making. *Journal of Knowledge Management*, 21(2), 275–294. [10.1108/JKM-07-2015-0296](#).
- Herbst, U., Voeth, M., & Meister, C. (2011). What do we know about buyer-seller negotiations in marketing research? A status quo analysis. *Industrial Marketing Management*, 40(6), 967–978. [10.1016/j.indmarman.2011.07.004](#).
- Higgins, J. P., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (2019). *Cochrane Handbook for Systematic Reviews of Interventions*. John Wiley & Sons.
- Hodgkinson, G. P., & Healey, M. P. (2011). Psychological foundations of dynamic capabilities: Reflexion and reflection in strategic management. *Strategic Management Journal*, 32(13), 1500–1516. [10.1002/smj.964](#).
- Hossain, M. S., Akter, S., & Yanamandram, V. (2020). Revisiting customer analytics capability for data-driven retailing. *Journal of Retailing and Consumer Services*, 56, Article 102187. [10.1016/j.jretconser.2020.102187](#).
- Hossain, M. S., & Muhammad, G. (2019). Emotion recognition using deep learning approach from audio-visual emotional big data. *Information Fusion*, 49, 69–78. [10.1016/j.inffus.2018.09.008](#).
- Hossain, M. S., Muhammad, G., & Al Qurishi, M. (2018). Verifying the images authenticity in cognitive internet of things (CIoT)-oriented cyber physical system. *Mobile Networks and Applications*, 23(2), 239–250. [10.1007/s11036-017-0928-4](#).
- Hristidis, V., Chen, S.-C., Li, T., Luis, S., & Deng, Y. (2010). Survey of data management and analysis in disaster situations. *Journal of Systems and Software*, 83(10), 1701–1714. [10.1016/j.jss.2010.04.065](#).
- Ijadi Maghsoodi, A., Riahi, D., Herrera-Viedma, E., & Zavadskas, E. K. (2020). An integrated parallel big data decision support tool using the W-CLUS-MCDA: A multi-scenario personnel assessment. *Knowledge-Based Systems*, 195, Article 105749. [10.1016/j.knosys.2020.105749](#).
- Inamdar, Z., Raut, R., Narwane, V. S., Gardas, B., Narkhede, B., & Sagnak, M. (2020). A systematic literature review with bibliometric analysis of big data analytics adoption from period 2014 to 2018. *Journal of Enterprise Information Management*, ahead-of-print (ahead-of-print). [10.1108/JEIM-09-2019-0267](#).
- Kar, A. K. (2015a). Reinvestigating vendor selection criteria in the iron and steel industry. *International Journal of Procurement Management*, 8(5), 570–586. [10.1504/IJPM.2015.070902](#).
- Kar, A. K. (2015b). Integrating websites with social media – An approach for group decision support. *Journal of Decision Systems*, 24(3), 339–353. [10.1080/12460125.2015.969585](#).
- Kar, A. K. (2020). What affects usage satisfaction in mobile payments? Modelling user generated content to develop the "digital service usage satisfaction model. *Information Systems Frontiers*. [10.1007/s10796-020-10045-0](#).
- Kar, A. K., & Dwivedi, Y. K. (2020). Theory building with big data-driven research – Moving away from the "What" towards the "Why". *International Journal of Information Management*, 54, Article 102205. [10.1016/j.ijinfomgt.2020.102205](#).
- Kar, A. K., Ilavarasan, V., Gupta, M. P., Janssen, M., & Kothari, R. (2019). Moving beyond Smart Cities: Digital nations for social innovation & sustainability. *Information Systems Frontiers*, 21(3), 495–501. [10.1007/s10796-019-09930-0](#).
- Kar, A. K., & Rakshit, A. (2015). Flexible pricing models for cloud computing based on group decision making under consensus. *Global Journal of Flexible Systems Management*, 16(2), 191–204. [10.1007/s40171-015-0093-1](#).
- Kar, S., Kar, A., & Gupta, M. P. (2020). Talent scarcity, skill distance and reskilling resistance in emerging digital technologies—understanding employee behaviour. In *ICIS 2020 Proceedings* [https://aisel.aisnet.org/icis2020/practice\\_is\\_research/practice\\_is\\_research/3](#).
- Karamitsos, I., Manifavas, C., & Amer, M. (2019). The influence of big data and IoT on smart cities. In W. A. Samad, & E. Azar (Eds.), *Smart Cities in the Gulf: Current State, Opportunities, and Challenges* (pp. 151–172). Springer. [10.1007/978-981-13-2011-8\\_9](#).
- Killoran, J. B. (2013). How to use search engine optimization techniques to increase website visibility. *IEEE Transactions on Professional Communication*, 56(1), 50–66. [10.1109/TPC.2012.2237255](#).
- Kim, Y., Kim, C., Lee, D. K., Lee, H., & Andrada, R. II. T. (2019). Quantifying nature-based tourism in protected areas in developing countries by using social big data. *Tourism Management*, 72, 249–256. [10.1016/j.tourman.2018.12.005](#).
- Kovács, G., & Spens, K. M. (2007). Humanitarian logistics in disaster relief op-



- erations. *International Journal of Physical Distribution & Logistics Management*. 10.1108/09600030710734820.
- Kowalkowski, C., Ridell, O. P., Røndell, J. G., & Sörhammar, D. (2012). The co-creative practice of forming a value proposition. *Journal of Marketing Management*, 28(13–14), 1553–1570. 10.1080/0267257X.2012.736875.
- Kumar, S., Kar, A. K., & Ilavarasan, V. (2020). Using big data analytics on social media to analyze tourism service encounters. In *Proceedings of AISE 2020*. Springer (Lecture Notes in Electrical Engineering).
- Kushwaha, A. K., Kar, A. K., & Vigneswara Ilavarasan, P. (2020). Predicting information diffusion on twitter a deep learning neural network model using custom weighted word features. In M. Hattingh, M. Matthee, H. Smuts, I. Pappas, Y. Dwivedi, & M. Mäntymäki (Eds.), *Responsible Design, Implementation and Use of Information and Communication Technology*. I3E 2020. *Lecture Notes in Computer Science*, vol 12066. Cham: Springer. 10.1007/978-3-030-44999-5\_38.
- Kushwaha, A. K., & Kar, A. K. (2020). Language model-driven chatbot for business to address marketing and selection of products. In S. K. Sharma, Y. K. Dwivedi, B. Metri, & N. P. Rana (Eds.), *Re-imagining Diffusion and Adoption of Information Technology and Systems: A Continuing Conversation* (pp. 16–28). Springer International Publishing. 10.1007/978-3-030-64849-7\_3.
- Kushwaha, A. K., Mandal, S., Pharswan, R., Kar, A. K., & Ilavarasan, P. V. (2020). Studying online political behaviours as rituals: A study of social media behaviour regarding the CAA. In S. K. Sharma, Y. K. Dwivedi, B. Metri, & N. P. Rana (Eds.), *Re-imagining Diffusion and Adoption of Information Technology and Systems: A Continuing Conversation* (pp. 315–326). Springer International Publishing. 10.1007/978-3-030-64861-9\_28.
- Kushwaha, A. K., & Kar, A. K. (2020). Micro-foundations of artificial intelligence adoption in business: Making the shift. In S. K. Sharma, Y. K. Dwivedi, B. Metri, & N. P. Rana (Eds.), *Re-imagining Diffusion and Adoption of Information Technology and Systems: A Continuing Conversation*. TDIT 2020. IFIP Advances in Information and Communication Technology, vol 617. Cham: Springer. 10.1007/978-3-030-64849-7\_22.
- Kushwaha, A. K., Kar, A. K., & Ilavarasan, P. V. (2020). Predicting retweet class using deep learning. *Trends in Deep Learning Methodologies: Algorithms, Applications, and Systems*, 89.
- Kusiak, A. (2017). Smart manufacturing must embrace big data. *Nature*, 544(7648), 23. 10.1038/544023a.
- Lai, K., Wong, C. W. Y., & Cheng, T. C. E. (2010). Bundling digitized logistics activities and its performance implications. *Industrial Marketing Management*, 39(2), 273–286. 10.1016/j.indmarman.2008.08.002.
- Lee, H., Aydin, N., Choi, Y., Lekhavat, S., & Irani, Z. (2018). A decision support system for vessel speed decision in maritime logistics using weather archive big data. *Computers & Operations Research*, 98, 330–342. 10.1016/j.cor.2017.06.005.
- Lee, Z. W. Y., Chan, T. K. H., Chong, A. Y.-L., & Thadani, D. R. (2019). Customer engagement through omnichannel retailing: The effects of channel integration quality. *Industrial Marketing Management*, 77, 90–101. 10.1016/j.indmarman.2018.12.004.
- Leightley, D., Chui, Z., Jones, M., Landau, S., McCrone, P., Hayes, R. D., Wessely, S., Fear, N. T., & Goodwin, L. (2018). Integrating electronic healthcare records of armed forces personnel: Developing a framework for evaluating health outcomes in England, Scotland and Wales. *International Journal of Medical Informatics*, 113, 17–25. 10.1016/j.ijmedinf.2018.02.012.
- Li, J., Xu, L., Tang, L., Wang, S., & Li, L. (2018). Big data in tourism research: A literature review. *Tourism Management*, 68, 301–323. 10.1016/j.tourman.2018.03.009.
- Liaqat, M., Chang, V., Gani, A., Hamid, S. H. A., Toseef, M., Shoaib, U., & Ali, R. I. (2017). Federated cloud resource management: Review and discussion. *Journal of Network and Computer Applications*, 77, 87–105. 10.1016/j.jnca.2016.10.008.
- Llewellyn, C., Grover, C., Alex, B., Oberlander, J., & Tobin, R. (2015). Extracting a Topic Specific Dataset from a Twitter Archive. In S. Kapidakis, C. Mazurek, & M. Werla (Eds.), *Research and Advanced Technology for Digital Libraries* (pp. 364–367). Springer International Publishing. 10.1007/978-3-319-24592-8\_36.
- Loebbecke, C., & Picot, A. (2015). Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda. *The Journal of Strategic Information Systems*, 24(3), 149–157. 10.1016/j.jsis.2015.08.002.
- Lunde, T. Å., Sjusdal, A. P., & Pappas, I. O. (2019). Organizational Culture Challenges of Adopting Big Data: A Systematic Literature Review. In I. O. Pappas, P. Mikalef, Y. K. Dwivedi, L. Jaccheri, J. Krogstie, & M. Mäntymäki (Eds.), *Digital Transformation for a Sustainable Society in the 21st Century* (pp. 164–176). Springer International Publishing. 10.1007/978-3-030-29374-1\_14.
- Ma, S. (David), Kirilenko, A. P., & Stepchenkova, S. (2020). Special interest tourism is not so special after all: Big data evidence from the 2017 Great American Solar Eclipse. *Tourism Management*, 77, Article 104021. 10.1016/j.tourman.2019.104021.
- Masoud, M., Jaradat, Y., Manasrah, A., & Jannoud, I. (2019). *Sensors of Smart Devices in the Internet of Everything (IoE) Era: Big Opportunities and Massive Doubts* [Review Article]. *Journal of Sensors; Hindawi*. 10.1155/2019/6514520.
- Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2019). Big Data Analytics Capabilities and Innovation: The Mediating Role of Dynamic Capabilities and Moderating Effect of the Environment. *British Journal of Management*, 30(2), 272–298. 10.1111/1467-8551.12343.
- Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2020). The role of information governance in big data analytics driven innovation. *Information & Management*, 57(7), Article 103361. 10.1016/j.im.2020.103361.
- Minbaeva, D. B. (2018). Building credible human capital analytics for organizational competitive advantage. *Human Resource Management*, 57(3), 701–713. 10.1002/hrm.21848.
- Mir, U. B., Kar, A. K., Dwivedi, Y. K., Gupta, M. P., & Sharma, R. S. (2020). Realizing digital identity in government: Prioritizing design and implementation objectives for Aadhaar in India. *Government Information Quarterly*, 37(2), Article 101442. 10.1016/j.giq.2019.101442.
- Mir, U. B., Sharma, S., Kar, A. K., & Gupta, M. P. (2020). Critical success factors for integrating artificial intelligence and robotics. *Digital Policy, Regulation and Governance*, 22(4), 307–331. 10.1108/DPRG-03-2020-0032.
- Mohan, R., & Kar, A. K. (2017). #Demonetization and Its Impact on the Indian Economy – Insights from Social Media Analytics. In A. K. Kar, P. V. Ilavarasan, M. P. Gupta, Y. K. Dwivedi, M. Mäntymäki, M. Janssen, A. Simintiras, & S. Al-Sharhan (Eds.), *Digital Nations – Smart Cities, Innovation, and Sustainability* (pp. 363–374). Springer International Publishing. 10.1007/978-3-319-68557-1\_32.
- Osuna Ramírez, S. A., Veloutsou, C., & Morgan-Thomas, A. (2019). I hate what you love: Brand polarization and negativity towards brands as an opportunity for brand management. *Journal of Product & Brand Management*, 28(5), 614–632. 10.1108/JPBPM-03-2018-1811.
- Palmieri, F., Ficco, M., Pardi, S., & Castiglione, A. (2016). A cloud-based architecture for emergency management and first responders localization in smart city environments. *Computers & Electrical Engineering*, 56, 810–830. 10.1016/j.compeleceng.2016.02.012.
- Pani, A. K., & Kar, A. K. (2011). A Study to Compare Relative Importance of Criteria for Supplier Evaluation in e-Procurement. In *2011 44th Hawaii International Conference on System Sciences* (pp. 1–8). 10.1109/HICSS.2011.35.
- Papadopoulos, T., Gunasekaran, A., Dubey, R., Altay, N., Childe, S. J., & Fosso-Wamba, S. (2017). The role of Big Data in explaining disaster resilience in supply chains for sustainability. *Journal of Cleaner Production*, 142, 1108–1118. 10.1016/j.jclepro.2016.03.059.
- Pencheva, I., Esteve, M., & Mikhaylov, S. J. (2020). Big Data and AI – A transformational shift for government: So, what next for research? *Public Policy and Administration*, 35(1), 24–44. 10.1177/0952076718780537.
- Phillips, P., Barnes, S., Zigan, K., & Schegg, R. (2017). Understanding the Impact of Online Reviews on Hotel Performance: An Empirical Analysis. *Journal of Travel Research*, 56(2), 235–249. 10.1177/0047287516636481.
- Price, W. N., & Cohen, I. G. (2019). Privacy in the age of medical big data. *Nature Medicine*, 25(1), 37–43. 10.1038/s41591-018-0272-7.
- Raghupathi, V., Zhou, Y., & Raghupathi, W. (2018). Legal Decision Support: Exploring Big Data Analytics Approach to Modeling Pharma Patent Validity Cases. *Nature Biotechnology*. 10.1109/ACCESS.2018.2859052.
- Ransbotham, S., & Kiron, D. (2017). Analytics as a Source of Business Innovation. *MIT Sloan Management Review*, 58(3) n/a-0.
- Ren, S., Zhang, Y., Liu, Y., Sakao, T., Huisings, D., & Almeida, C. M. V. B. (2019). A comprehensive review of big data analytics throughout product lifecycle to support sustainable smart manufacturing: A framework, challenges and future research directions. *Journal of Cleaner Production*, 210, 1343–1365. 10.1016/j.jclepro.2018.11.025.
- Ritter, T., & Pedersen, C. L. (2020). Digitization capability and the digitalization of business models in business-to-business firms: Past, present, and future. *Industrial Marketing Management*, 86, 180–190. https://doi.org/10.1016/j.indmarman.2019.11.019
- Rovero, F., & Ahumada, J. (2017). The Tropical Ecology, Assessment and Monitoring (TEAM) Network: An early warning system for tropical rain forests. *Science of The Total Environment*, 574, 914–923. 10.1016/j.scitotenv.2016.09.146.
- Rumsfeld, J. S., Joynt, K. E., & Maddox, T. M. (2016). Big data analytics to improve cardiovascular care: Promise and challenges. *Nature Reviews Cardiology*, 13(6), 350–359. 10.1038/nrcardio.2016.42.
- Santoro, G., Fiano, F., Bertoldi, B., & Ciampi, F. (2019). Big data for business management in the retail industry. *Management Decision*, 57(8), 1980–1992. 10.1108/MD-07-2018-0829.
- Sarin, P., Kar, A. K., Kewat, K., & Ilavarasan, P. V. (2020). Factors affecting future of work: Insights from Social Media Analytics. *Procedia Computer Science*, 167, 1880–1888. 10.1016/j.procs.2020.03.207.
- Sbai, I., & Krichen, S. (2020). A real-time decision support system for big data analytic: A case of dynamic vehicle routing problems. *Procedia Computer Science*, 176, 938–947. 10.1016/j.procs.2020.09.089.
- Sen, R. (2005). Optimal search engine marketing strategy. *International Journal of Electronic Commerce*, 10(1), 9–25. 10.1080/10864415.2005.11043964.
- Shang, C., & You, F. (2019). Data analytics and machine learning for smart process manufacturing: Recent advances and perspectives in the big data era. *Engineering*, 5(6), 1010–1016. 10.1016/j.eng.2019.01.019.
- Shilo, S., Rossman, H., & Segal, E. (2020). Axes of a revolution: Challenges and promises of big data in healthcare. *Nature Medicine*, 26(1), 29–38. 10.1038/s41591-019-0727-5.
- Sivarajah, U., Irani, Z., Gupta, S., & Mahroof, K. (2020). Role of big data and social media analytics for business to business sustainability: A participatory web context. *Industrial Marketing Management*, 86, 163–179. https://doi.org/10.1016/j.indmarman.2019.04.005
- Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333–339. 10.1016/j.jbusres.2019.07.039.
- Sorescu, A., Frambach, R. T., Singh, J., Rangaswamy, A., & Bridges, C. (2011). Innovations in Retail Business Models. *Journal of Retailing*, 87, S3–S16. 10.1016/j.jretai.2011.04.005.
- Sun, Y., Shi, Y., & Zhang, Z. (2019). Finance Big Data: Management, Analysis, and Applications. *International Journal of Electronic Commerce*, 23(1), 9–11. 10.1080/10864415.2018.1512270.
- Tabari, M. Y., Memariani, A., Ebadati, E., & O. M. (2019). Developing a decision support system for big data analysis and cost allocation in national healthcare. In N. Dey, A. S. Ashour, C. Bhatt, & S. James Fong (Eds.), *Healthcare Data Analytics and Management* (pp. 89–109). Academic Press. 10.1016/B978-0-12-815368-0.00003-8.
- Tallon, P. P. (2013). Corporate Governance of Big Data: Perspectives on Value, Risk, and Cost. *Computer*, 46(6), 32–38. 10.1109/MC.2013.155.
- Tao, F., Qi, Q., Liu, A., & Kusiak, A. (2018). Data-driven smart manufacturing. *Journal of Manufacturing Systems*, 48, 157–169. 10.1016/j.jmsy.2018.01.006.
- Tse, D., Chow, C., Ly, T., Tong, C., & Tam, K. (2018). The Challenges of Big Data Governance in Healthcare. In *2018 17th IEEE International Conference On Trust, Security And Privacy In Computing And Communications/12th IEEE International Conference On Big*



- Data Science And Engineering (TrustCom/BigDataSE)* (pp. 1632–1636). [10.1109/TrustCom/BigDataSE.2018.00240](https://doi.org/10.1109/TrustCom/BigDataSE.2018.00240).
- Tsouri, M., & Pegoretti, G. (2020). Structure and resilience of local knowledge networks: The case of the ICT network in Trentino. *Industry and Innovation*, 0(0), 1–20. [10.1080/13662716.2020.1775070](https://doi.org/10.1080/13662716.2020.1775070).
- Twarogowska, M., Goatin, P., & Duvigneau, R. (2014). Macroscopic modeling and simulations of room evacuation. *Applied Mathematical Modelling*, 38(24), 5781–5795. [10.1016/j.apm.2014.03.027](https://doi.org/10.1016/j.apm.2014.03.027).
- Vayena, E., & Blasimme, A. (2017). Biomedical Big Data: New Models of Control Over Access, Use and Governance. *Journal of Bioethical Inquiry*, 14(4), 501–513. [10.1007/s11673-017-9809-6](https://doi.org/10.1007/s11673-017-9809-6).
- Vieira, V. A., de Almeida, M. I. S., Agnihotri, R., da Silva, N. S. D. A. C., & Arunachalam, S. (2019). In pursuit of an effective B2B digital marketing strategy in an emerging market. *Journal of the Academy of Marketing Science*, 47(6), 1085–1108. [10.1007/s11747-019-00687-1](https://doi.org/10.1007/s11747-019-00687-1).
- Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J., Dubey, R., & Childe, S. J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. *Journal of Business Research*, 70, 356–365. [10.1016/j.jbusres.2016.08.009](https://doi.org/10.1016/j.jbusres.2016.08.009).
- Wang, X., Reger, R. K., & Pfarrer, M. (2019). Faster, hotter, and more linked in: Managing social disapproval in the social media era. *Academy of Management Review*. [10.5465/amr.2017.0375](https://doi.org/10.5465/amr.2017.0375).
- Wang, Y., Chen, C., Wang, J., & Baldick, R. (2016). Research on Resilience of Power Systems Under Natural Disasters—A Review. *IEEE Transactions on Power Systems*, 31(2), 1604–1613. [10.1109/TPWRS.2015.2429656](https://doi.org/10.1109/TPWRS.2015.2429656).
- Watson, H., Finn, R. L., & Wadhwa, K. (2017). Organizational and societal impacts of big data in crisis management. *Journal of Contingencies and Crisis Management*, 25(1), 15–22. [10.1111/1468-5973.12141](https://doi.org/10.1111/1468-5973.12141).
- Wu, F., Huang, Y., & Yuan, Z. (2017). Domain-specific sentiment classification via fusing sentiment knowledge from multiple sources. *Information Fusion*, 35, 26–37. [10.1016/j.inffus.2016.09.001](https://doi.org/10.1016/j.inffus.2016.09.001).
- Xiang, Z., & Fesenmaier, D. R. (2017). Big Data Analytics, Tourism Design and Smart Tourism. In Z. Xiang, & D. R. Fesenmaier (Eds.), *Analytics in Smart Tourism Design: Concepts and Methods* (pp. 299–307). Springer International Publishing. [10.1007/978-3-319-44263-1\\_17](https://doi.org/10.1007/978-3-319-44263-1_17).
- Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research*, 39(1), 93–112. [10.1177/0739456X17723971](https://doi.org/10.1177/0739456X17723971).
- Yang, T. (2019). ICT technologies standards and protocols for active distribution network. In Q. Yang, T. Yang, & W. Li (Eds.), *Smart Power Distribution Systems* (pp. 205–230). Academic Press. [10.1016/B978-0-12-812154-2.00010-9](https://doi.org/10.1016/B978-0-12-812154-2.00010-9).
- Yaqoob, I., Hashem, I. A. T., Gani, A., Mokhtar, S., Ahmed, E., Anuar, N. B., & Vasilakos, A. V. (2016). Big data: From beginning to future. *International Journal of Information Management*, 36(6, Part B), 1231–1247. [10.1016/j.ijinfomgt.2016.07.009](https://doi.org/10.1016/j.ijinfomgt.2016.07.009).
- Zhang, L., Liu, X., Li, Y., Liu, Y., Liu, Z., Lin, J., Shen, J., Tang, X., Zhang, Y., & Liang, W. (2012). Emergency medical rescue efforts after a major earthquake: Lessons from the 2008 Wenchuan earthquake. *The Lancet*, 379(9818), 853–861. [10.1016/S0140-6736\(11\)61876-X](https://doi.org/10.1016/S0140-6736(11)61876-X).
- Zhang, X., Ming, X., & Yin, D. (2020). Application of industrial big data for smart manufacturing in product service system based on system engineering using fuzzy DEMATEL. *Journal of Cleaner Production*, 265, Article 121863. [10.1016/j.jclepro.2020.121863](https://doi.org/10.1016/j.jclepro.2020.121863).
- Zheng, P., Wang, H., Sang, Z., Zhong, R. Y., Liu, Y., Liu, C., Mubarak, K., Yu, S., & Xu, X. (2018). Smart manufacturing systems for Industry 4.0: Conceptual framework, scenarios, and future perspectives. *Frontiers of Mechanical Engineering*, 13(2), 137–150. [10.1007/s11465-018-0499-5](https://doi.org/10.1007/s11465-018-0499-5).