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The Impact of Big Data on Decision-Making, Processes And Organizational Change: an Introduction

Jean-Michel SAHUT
IDRAC Business School, Lyon (FR)

Emmanuel FRAGNIERE
HES-SO Valais-Wallis, University of Applied Science of Western Switzerland (CH)

Rey DANG
ISTEC Business School Paris (FR)

Abstract

This special issue looks at how big data affects business decisions, processes, and change. The issue starts with a review of the latest research in the field, including key developments and ongoing debates. The literature review shows how Big Data is affecting how organizations work, including ethical issues, rules, and using new technology. Next, the issue presents three key papers on how Big Data affects modern organizations. The first paper looks at how Big Data helps make better business decisions. The second paper looks at how Big Data tools help make processes more efficient in different industries. The third paper looks at how new technologies like AI, blockchain, and quantum computing affect organizations. Together, these contributions show the need to balance innovation with risk mitigation. They advocate for ethical considerations and policy frameworks as organizations navigate the complexities of the Big Data era. The content of this special issue, from literature review to focused studies on decision-making, operations, and organizational change, provides a holistic understanding of the role of Big Data in shaping the future of business.

Keywords: Big Data Analytics, Strategic Decision-Making, Operational Efficiency, Organizational Change, Emerging Technologies, Ethical Considerations

1. Introduction

Big Data is a term used to describe data that is too massive, quick, and complicated to be effectively managed using conventional methods or software within a reasonable timeframe (Snijders et al., 2012). The term gained prominence in the early 2000s with the advent of technologies capable of processing large volumes of data. According to McAfee and Brynjolfsson (2012), the three Vs of Big Data—Volume, Velocity, and Variety—define its core characteristics. These have since been expanded to include Veracity and Value (Gandomi & Haider, 2015).

The evolution of Big Data can be traced back to the proliferation of digital technologies. The rise of the internet, social media platforms, IoT devices, and mobile applications has led to an exponential increase in data generation. IDC (International Data Corporation) predicted that the global data sphere would grow to 175 zettabytes by 2025, underscoring the rapid pace of data generation (Reinsel, Gantz, & Rydning, 2018).

The utilization of Big Data for identifying relationships and predicting events and behavior has been accelerated by advancements in mathematical analysis, including optimization, inductive statistics, and non-linear system identification. Organizations strive to utilize customer data in a responsible manner while also seeking to maximize its economic value. Consequently, client data is now regarded as a valuable strategic resource. The idea is to optimize its utility while reducing security issues.

Over the past decade, there has been significant study and business conversations on the profound influence of Big Data on decision-making, procedures, and organizational change. The immense quantity, speed, diversity, and accuracy of data generated in the digital era present both difficulties and possibilities for enterprises aiming to maintain competitiveness. This introduction examines the vast amount of literature on Big Data, specifically looking at how it affects decision-making, the incorporation of advanced data analytics into organizational processes, and the resulting changes inside organizations. It presents important theories and concepts created by experts and professionals in this field, providing a comprehensive overview supported by empirical evidence and theoretical frameworks.

This special issue deals with how Big Data can improve decision-making. This leads to changes in company processes, and more generally at organizational level. The goal of this introduction is to review and assess recent research on Big Data, and to suggest future directions of research. The remainder of this paper proceeds as follows. In Section 2, we discuss our vision of the

literature, and in Section 3 how the selected articles for this special issue contribute to it. Avenues for future research and concluding remarks follow in Section 4.

2. Our vision of the literature

Our synthesis of the literature on the impacts of Big Data on decision-making, processes and organizational change, has led us to distinguish organizational impacts from the theories and methods used to explore these impacts.

2.1/ The organizational impact of big data on companies

With the aim of better understanding the impact of Big Data on firms in terms of integration into their processes and the organizational changes this requires, we first look at the role of Big Data in decision-making

2.1.1/ The role of Big Data in decision-making

Experience, intuition, and a limited amount of facts have traditionally been the three primary factors that have been considered while making decisions in businesses. Big data, on the other hand, has completely altered the way this procedure is carried out. In their 2012 article, Davenport, Barth, and Bean claim that data-driven decision-making (DDDM) gives businesses the ability to make decisions that are both more accurate and more timely. Organizations are able to recognize patterns, forecast trends, and improve their strategy when they make use of data analytics.

The advantages of DDDM have been the subject of a number of other investigations. For instance, Brynjolfsson, Hitt, and Kim (2011) discovered that businesses that adopted data-driven decision-making had results that were five to six percent greater in terms of output and productivity than their alternative businesses. McAfee and Brynjolfsson (2012) made a similar observation, stating that companies that are driven by data are more likely to beat their competitors in terms of financial and operational dimensions.

Big data plays a particularly significant role in decision-making, and this is especially visible in industries such as retail, healthcare, and finance. Personalization of marketing and optimization of inventory are both made possible by Big Data analytics in the retail industry. According to Smith and Linden (2017), Amazon's recommendation system, which takes into

account a customer's browsing activity and purchase history, has resulted in a considerable increase in both the company's sales and the level of happiness experienced by its customers.

Big data-based predictive analytics have the potential to enhance patient outcomes in the healthcare industry by facilitating early diagnosis and the development of individualized treatment regimens. A thorough understanding of a patient's health can be obtained by the integration of data from electronic health records, wearable devices, and genomic sequencing, as Kudyba (2014) demonstrates.

2.1.2 / Integrating Big Data into organizational processes

It is necessary to make considerable technological and structural adjustments in order to successfully incorporate Big Data into organizational processes. When it comes to managing the volume, velocity, and variety of Big Data, traditional data management systems frequently struggle to meet the challenge. As a consequence of this, businesses are embracing cutting-edge technology such as cloud computing, distributed databases, and machine learning algorithms.

Cloud computing provides enterprises with scalable storage and processing capability, which makes it simpler for them to manage massive datasets. Data that is not organized and comes from a variety of sources can be stored and processed using distributed databases like Hadoop and NoSQL. These databases offer the flexibility that is required. The work that Dean and Ghemawat (2008) have done on MapReduce, which is a programming methodology for processing massive data sets, has been extremely helpful in enabling efficient data analysis.

Through the automation of pattern identification and predictive modeling, machine learning algorithms allow for an even greater improvement in the capability to analyze Big Data. According to Domingos (2012), machine learning has the potential to unearth valuable insights that are not readily visible through the use of conventional statistical methods. For instance, according to Ngai, Hu, Wong, Chen, and Sun (2011), machine learning algorithms are utilized in the financial industry for the purpose of discovering fraudulent activity through the examination of transaction patterns and the identification of anomalies.

Developing a solid data governance structure is another step that must be taken in order to successfully integrate Big Data into business processes. A part of this involves the establishment of policies on the quality of data, security, and privacy. According to Redman (2013), the Big Data Governance Model introduced by IBM is widely considered to be a best practice. This model places a strong emphasis on the necessity of data stewardship and compliance.

2.1.3/ Organizational Change Driven by Big Data

Significant organizational shifts are required in order to accommodate the implementation of Big Data technology. The influence of this transition is multidimensional, covering not just technological but also cultural and structural aspects. The cultivation of a data-driven culture within a company, in which data is regarded as a strategic asset, is necessary for enterprises to fully harness the potential of Big Data.

In order to cultivate a culture that is driven by data, it is necessary to encourage data literacy at every level of the business, as stated by Harris and Mehrotra (2014). In order to accomplish this, staff need to be trained to comprehend and make use of data in their day-to-day tasks. In addition, the senior management of the organization needs to demonstrate their dedication to making decisions based on data by incorporating data analytics into the process of strategy planning and performance review.

There is a possibility that structural adjustments are required in order to accommodate Big Data ambitions. The Chief Data Officer (CDO), data scientists, and data engineers are just few of the specialized positions that are being created by numerous types of enterprises. The Chief Data Officer (CDO) is accountable for the development and implementation of the organization's data strategy, as well as the promotion of innovation and the guaranteeing of data quality (Lee, 2017). On the other side, data scientists and engineers are tasked with the responsibility of analyzing data and designing algorithms in order to extract insights that can be put into action.

Additionally, addressing ethical and privacy concerns is a necessary component of the organizational change that is driven by Big Data. Questions of consent, data security, and openness are raised when considering the acquisition and utilization of huge amounts of data. The General Data Protection Regulation (GDPR) in Europe and the California Consumer Privacy Act (CCPA) in the United States are two examples of regulations that highlight the significance of safeguarding the privacy rights of individuals (Voigt & Von dem Bussche, 2017).

2.1.4/ An illustration of these transformative impacts

Numerous case studies illustrate the transformative impact of Big Data on organizations. For example, a global e-commerce giant, Amazon, has leveraged Big Data analytics to optimize its supply chain, personalize customer experiences, and enhance decision-making. By analyzing vast amounts of data from customer interactions, purchases, and logistics, Amazon can predict

demand, manage inventory, and recommend products tailored to individual preferences (Davenport & Harris, 2017).

In the healthcare sector, the use of Big Data has led to significant improvements in patient care and operational efficiency. For instance, the Mayo Clinic utilizes Big Data analytics to develop predictive models for disease outbreaks and personalize treatment plans based on patients' genetic profiles (Raghupathi & Raghupathi, 2014). This data-driven approach has improved patient outcomes and reduced healthcare costs.

The financial industry has also benefited from Big Data analytics. Banks and financial institutions use Big Data to enhance risk management, detect fraud, and optimize trading strategies. For example, JP Morgan Chase employs machine learning algorithms to analyze transaction data and identify fraudulent activities, thereby protecting customers and reducing losses (Dervovic et al., 2023). According to Ahmadi. (2024), the combination of Big Data and AI has the ability to bring about significant changes in the financial sector, extending beyond just improving operations. These technologies will open up new possibilities for growth and advancement, providing financial institutions with a slight advantage in operational efficiency and the ability to offer innovative products and services.

In addition, Big data significantly influences public management and the development of smart cities by enhancing decision-making, optimizing resource allocation, and improving service delivery (Wang, 2024). The Influence of Big Data on public management lies mainly at two levels, decision-making and resource allocation. Big data enables governments to make more informed policy decisions by evaluating massive amounts of information from a variety of sources. For example, social media analysis can assess public opinion on proposed initiatives. Predictive analytics can help governments foresee patterns and prospective concerns, such as traffic congestion or disease outbreaks, allowing them to take proactive actions (Olaniyi et al., 2023). Lastly, Big data can assist discover inefficiencies in public services including healthcare, education, and transportation. Governments can enhance service delivery and resource allocation by examining usage trends and performance metrics.

Wang, Y. (2024). The Impact and Challenges of Big Data Applications in Smart City Management. The Frontiers of Society, Science and Technology, 6(2).

Olaniyi, O., Okunleye, O. J., & Olabanji, S. O. (2023). Advancing data-driven decision-making in smart cities through big data analytics: A comprehensive review of existing literature. Current Journal of Applied Science and Technology, 42(25), 10-18.

The advent of big data and AI has brought about significant cultural and societal impacts, presenting both opportunities and challenges. These technologies have the potential to enhance decision-making processes, stimulate innovation, and deliver social benefits across a range of sectors (Cuquet et al., 2017). Nevertheless, these technologies also give rise to ethical concerns pertaining to privacy, security, and the potential for discriminatory practices (White & Ariyachandra, 2019). The deployment of big data in social computing systems necessitates a meticulous examination of cultural, political, and societal factors, as well as the input of diverse academic disciplines, to guarantee an ethically sound design process (Garcia et al., 2020). It is imperative that legal frameworks address issues such as copyright, data protection, and anti-discrimination in order to mitigate any negative impacts (Cuquet et al., 2017). Moreover, the ethical implications of digital culture and the challenges posed by new power techniques associated with big data demand attention from governments, academia, and civil society (Janssen and Kuk, 2016). It is of the utmost importance to strike a balance between the advantages offered by big data and AI and the ethical considerations that accompany their implementation in society.

Cuquet, M., Vega-Gorgojo, G., Lammerant, H., & Finn, R. (2017). Societal impacts of big data: challenges and opportunities in Europe. arXiv preprint arXiv:1704.03361.

White, G., Ariyachandra, T., & White, D. (2019). Big Data, Ethics, and Social Impact Theory–A Conceptual Framework. Journal of Management & Engineering Integration, 12(1).

Garcia, P., Darroch, F., West, L., & BrooksCleator, L. (2020). Ethical applications of big data-driven AI on social systems: Literature analysis and example deployment use case. Information, 11(5), 235.

Janssen, M., & Kuk, G. (2016). The challenges and limits of big data algorithms in technocratic governance. Government Information Quarterly, 33(3), 371-377.

Finally, the application of Big Data technologies offers considerable potential for the resolution of climate change challenges and the facilitation of energy transitions. These technologies are capable of analyzing vast quantities of data from a multitude of sources, thereby enhancing the precision of climate change predictions and facilitating the development of efficacious mitigation strategies (Cravero et al., 2020). The application of Big Data architectures has been observed in a number of sectors affected by climate change, including health, agriculture, and energy (Cravero et al., 2020). In the energy sector, the application of Big Data is facilitating the transition towards renewable sources and energy efficiency, thereby supporting the four pillars

of decarbonization, decentralization, digitization, and democratization (Doukas, 2022). Furthermore, Big Data can facilitate climate change adaptation and resilience by providing information on forthcoming issues, current challenges, and recovery stages (Sarker et al., 2020). Notwithstanding its potential, the climate change adaptation community has largely failed to acknowledge the developments in Big Data that have the potential to revolutionize our understanding of how to manage climate change risks (Ford et al., 2016).

Cravero, A., Sepúlveda, S., & Muñoz, L. (2020). Big Data Architectures for the Climate Change Analysis: A Systematic Mapping Study. *IEEE Latin America Transactions*, *18*(10), 1793-1806.

Doukas, H. (2022, July). Energy Transitions, Intelligence and Big data: Towards a prosumer concept with energy autonomy. In 2022 13th International Conference on Information, Intelligence, Systems & Applications (IISA) (pp. 1-5). IEEE.

Sarker, M. N. I., Yang, B., Yang, L., Huq, M. E., & Kamruzzaman, M. M. (2020). Climate change adaptation and resilience through big data. International Journal of Advanced Computer Science and Applications, 11(3).

Ford, J. D., Tilleard, S. E., Berrang-Ford, L., Araos, M., Biesbroek, R., Lesnikowski, A. C., ... & Bizikova, L. (2016). Big data has big potential for applications to climate change adaptation. Proceedings of the National Academy of Sciences, 113(39), 10729-10732.

2.2/ Theories and methodological approaches to explore Big Data

At the heart of Big Data analytics are a number of key theories, models, and concepts that form the foundation of this dynamic and evolving field. One of the fundamental principles of Big Data is the notion that traditional data management and analysis techniques are no longer sufficient to handle the sheer scale and complexity of the data being generated. As a result, new approaches and methodologies have emerged to address the unique challenges posed by Big Data, such as the need for scalable, distributed computing architectures and advanced analytical techniques like machine learning and deep learning.

2.2.1 / Theories, models and concepts in Big Data analytics

The field of Big Data is shaped by broad theoretical frameworks and models that seek to understand the strategic and organizational implications of this data-driven approach to decision-making and management of information systems. Based on the theories used in information systems, organization and innovation management, a special body of literature then

emerged, producing new models and concepts to understand and optimize the use of Big Data in organizations.

Among the multitude of concepts, three stand out in the literature: Big Data value chain, Data-driven organization, and Big Data analytics capabilities. We have not included the concept of data governance, as it is not specific to Big Data, but exists for all types of data. Big Data gives it added importance, because the sheer volume of data inherent in Big Data exacerbates the problems and challenges of Data Governance.

The concept of Big Data value chain outlines the stages of data generation, collection, storage, processing, analysis, and visualization (Chen, Chiang, & Storey, 2012). It highlights the importance of integrating data analytics into each stage of the value chain to derive maximum value.

Another important concept is the "data-driven organization" which emphasizes the importance of data-informed decision-making and the integration of analytics into core business processes, as well as models for deriving business value from Big Data, such as the concept of data-driven decision-making, which emphasizes the importance of using data and analytics to inform and guide organizational decision-making processes across all levels of the business (Fischer et al., 2023). This includes developing a culture that values data-driven insights and incorporating analytics into key strategic and operational decisions.

Finally, the concept of Big Data Analytics capabilities (BDAC) stems from the abundant literature on dynamic capacities. BDAC enabled sensing identification opportunities that initiate the mobilization of resources to transform firms' business models to enhance innovation and/or performance (Sabharwal & Miah, 2021). For example, Jenkinson et al. (2024) examines the correlation between BDAC and competitive performance and suggests that this link is influenced by Business Model Innovation. So, they recommend that practitioners should allocate resources to develop and improve their BDAC in order to increase the likelihood of success in their BMI endeavors.

2.2.2/ New approaches and methodologies

From this new literature on Big Data, two fundamental points emerge when we look at the approaches and methods deployed to harness the potential of this fantastic mass of data: data preprocessing and the necessary use of artificial intelligence to exploit their full potential.

Data preprocessing refers to the necessity to transform and clean of raw data to prepare it for analysis. This is a critical step in the analytics process, as the quality and integrity of the data can have a significant impact on the reliability and accuracy of the insights derived from it. Moreover, the rise of cloud computing has revolutionized the field of Big Data analytics by providing a highly scalable, cost-effective, and flexible platform for hosting and processing large datasets, enabling organizations to leverage the power of Big Data without the need for significant upfront investment in infrastructure (Hariharakrishnan et al., 2017). Sama (2024) highlights the role of data governance and pre-processing in mitigating the problems of interpretability posed by big data.

In this age of digital transformation, big data has emerged as the foundation upon which the creation of powerful artificial intelligence (AI) systems is built. The impact of this is that the interaction between large data and the interpretability and explicability of AI models has become more complicated (Gao & Guan, 2023). In order to improve their forecast accuracy and performance, artificial intelligence systems are increasingly relying on enormous datasets. As a result, the complexity of these models frequently rises, which introduces substantial hurdles in terms of their interpretability and explicability. Undoubtedly, the transparency of artificial intelligence models is impacted by the volume, diversity, and speed of Big Data. Researchers are forced to make a choice between the complexity of the models they construct and the interpretability of those models since it is difficult to grasp the decision-making processes of models that have been trained on huge and diverse data sets. A reduction in interpretability has significant ethical and regulatory ramifications, particularly in high-stakes industries such as healthcare, banking, and autonomous systems. This is in addition to the fact that it can lead to errors in decision-making. As an illustration, Sama (2024) investigates case studies in which artificial intelligence models based on large data lead to opaque decision-making. This helps to highlight the necessity of robust explicability in order to guarantee accountability and create confidence. Additionally, the project investigates other methods that are currently being developed to enhance the interpretability of complicated artificial intelligence models. These methods include hybrid models, visualization tools, and interpretable machine learning algorithms. A consensus among scholars and practitioners emerges as a consequence of synthesizing the findings of a number of research and the opinions of experts in order to strike a compromise between the advantages of Big Data and the requirement for AI models that are visible and explainable. Consequently, this highlights the significance of fostering collaboration

across academic lines in order to develop creative solutions that enhance the interpretability and explicability of artificial intelligence systems within the setting of larger amounts of data.

3. Selected papers

This special issue of CJAS brings together papers on Big data, following a perspective based on decision-making, processes and organizational change perspective. Given CJAS's selective reviewing process, three articles were accepted for publication, which allows us to explore that part of the literature outlined in the previous section. In the following we briefly introduce each article, how it contributes to the topic and perspectives of this special issue.

The first paper "*Crowdfunding Technology Projects: The Impact of Textual Characterization on Project Success"* by Abraham Yosipof, Yang Song, Noah Gradovitch, and Eric Braune, questions the success factors for fundraising in the technology sector.

The purpose of this study is to present a mixed strategy that includes data mining and text mining methods for the purpose of achieving success with crowdfunding and discovering trends in technology. The problem with evaluating this type of technological project and deciding to invest in it is that there are strong uncertainties about the project (environment, competitive advantage, future market…) and a high degree of information asymmetry between the project owners and the investors (the crowd). Since a traditional financial valuation is impossible to estimate the project's profitability, investors rely on weak signals to decide whether to invest, and thus determine the success or failure of the fund-raising. This research aims to identify these weak signals in the mass of data published on projects seeking to raise funds. A total of 17,733 projects, including 6,407 successful projects and 11,326 unsuccessful projects, are analyzed from the Kickstarter platform during a period of ten years, beginning in 2009 and ending in 2019. This study identifies a number of factors, including textual characteristics, that have been found as exerting an influence on the success of crowdfunding technology campaigns. Investors' mimetic behavior may give the impression that they are irrational. However, their examination of the textual variables of projects actually provides them with more valuable insights than traditional financial information and business plans, which may not accurately represent market realities. These factors also disclose the technology trend that investors prefer the most. These findings not only provide helpful insights but also bring to light major prospects for crowdfunding within the framework of technology.

The second paper "*Research Trends in the Application of Big Data in Smart Cities - A Literature Review"* by Abdelrahman Youssef, Petr Hajek, and Lubica Hikkerova, focuses on a collection of 192 articles published in the previous five years that explore the interaction of big data and the smart city context. The authors employ text analysis to ascertain current patterns and potential avenues for future research. The primary research fields that have a significant impact are big data analytics, electric vehicle integration, and citizen-centric big data. A recent addition to these research areas is the study of green space. Their findings emphasize that big data has the capacity to impact eight distinct aspects of smart cities, with smart mobility garnering the highest level of interest among researchers studying the utilization of big data in smart cities. Conversely, the qualities of intelligent individuals and a thriving economy have received the least amount of investigation from this standpoint.

The third paper "*Generalizing the use of Big data in market finance, between myths and realities: a work-based approach institutional"* (in French: *"Généralisation de l'usage du Big data en finance de marché, entre mythes et réalités: une approche par le travail institutionnel"*) by Liottier Miguel, Delecolle Thierry, and Quesmi Khaled, examines the use of Big Data and, more specifically, artificial intelligence-based trading algorithms in the field of market finance.

By conducting a lexicometric analysis of a corpus sourced from the finance press spanning a decade, the researcher identifies four key actors involved in the process of establishing the utilization of Big Data in market finance. These actors include experts from the banking and financial sector, intellectuals (such as academics, journalists, and writers), resource-seeking managers, and public institutions. Although ethical concerns and the potential for qualification exist, only public institutions openly acknowledge and address them as part of the institutionalization process.

4. Conclusion : Future Trends and Challenges

Big Data is a powerful force reshaping decision-making, processes, and organizational change. Its impact is evident across various sectors, from retail and healthcare to finance and manufacturing. By enabling more informed decisions, optimizing processes, and driving organizational change, Big Data offers immense potential for enhancing efficiency, innovation, and competitiveness. However, realizing this potential requires a holistic approach that addresses technological, cultural, and ethical dimensions. As organizations continue to navigate

the complexities of the data-driven era, those that can effectively leverage Big Data will be well-equipped to achieve sustained success.

The future of Big Data in organizations is poised for further growth and innovation. Emerging technologies such as artificial intelligence (AI), blockchain, and quantum computing are expected to enhance Big Data capabilities. AI, in particular, holds significant promise for automating data analysis and uncovering deeper insights. For instance, AI algorithms can process and analyze data at unprecedented speeds, enabling real-time decision-making (Russell & Norvig, 2021).

Blockchain technology offers potential solutions for data security and transparency. By providing a decentralized and immutable ledger, blockchain can ensure the integrity and traceability of data transactions, addressing some of the privacy and security concerns associated with Big Data (Yli-Huumo, Ko, Choi, Park, & Smolander, 2016).

Quantum computing, although still in its nascent stages, promises to revolutionize data processing by solving complex problems that are currently intractable for classical computers. This could significantly enhance the ability to analyze and interpret Big Data, leading to new insights and innovations (Arute et al., 2019).

However, the future also presents challenges. Ensuring data privacy and security will remain paramount as data breaches and cyber threats become more sophisticated. Organizations must invest in robust cybersecurity measures and comply with evolving regulations to protect sensitive data. Additionally, addressing the ethical implications of Big Data, such as algorithmic bias and the digital divide, will be critical for sustainable and equitable growth.

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