Big Data and Decision-Making

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Big Data and Decision-Making: Applications and Uses in the Public and Private Sector

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Editors' Preface

Very few topics remain as opaque and unclear to the broader public today as "big data". Similarly, as artificial intelligence, big data has turned into a buzzword of our times, frequently deployed absolutely uncritically as a veil usurping to be an explanation. Against this backdrop, the rationale behind this book was to offer a simple, but not simplistic, insight into the realm of big data, its application, and implications. The selections of chapters included in this book will guide the reader through diverse fields and domains of big data's use and application, including public policy, the business sector, including managerial practices, as well as smart cities' growth and management. This book is by no means exhaustive. Rather, it recognizes the value of the debate unfolding in the literature. By so doing it seeks to add to the debate in a manner that may be useful to researchers, practitioners, as well as to those of us who are also involved in teaching. The idea here is that all frequently topics pertaining to big data constitute either a part of papers too sophisticated for an average student to comprehend, or form a part of overly simplified, even if fancy, magazine content. And yet, it is mandatory that similarly as in our research, also in our teaching we go beyond what the curriculum defines as needed.

This book is a tribute to teamwork in that it would not be possible without the Publisher, especially the Commissioning Editor, Ms Iram [ir-rum] Satti who embraced the idea of the book and skillfully guided us through the initial reviews and the subsequent production process. We would also like thank the reviewers and the contributing authors. We remain grateful to the entire production team, who were consequential in the stages of the cover design, proofs, etc. In brief, a great number of people, forming a virtual team, collaborated to have this book delivered. We, the Editors, can only hope that this book will be of use to the broader audience.

We dedicate this book to fellow researchers, who – similarly as we do – seek to find a balance between the idealistic urge to explore and conduct research, the necessity to make ends meet by delivering on the teaching load, and private life.

The Editors: Anna Visvizi, Orlando Troisi
and Mara Grimaldi

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Chapter 1

Big data and Decision-making: How Big Data Is Relevant Across Fields and Domains

Anna Visvizi, Orlando Troisi and Mara Grimaldi

Abstract

Big data is a buzzword of our times, and yet the awareness of what big data is, how it permeates our daily lives, and how it is applied either in the policy-making process or in the business sector remains relatively low. From a different perspective, while specialists, that is, practitioners and researchers, dealing with the technical facets of big data successfully uncover new features, new domains, and new opportunities related to big data, there is a need of evaluating and examining these findings through the lens of social sciences and management. This chapter offers an insight into key issues and developments that shape the broad and multi-directional big data debate. To this end, the content of the book is elaborated and the key findings are highlighted. In this way, this chapter serves as a very useful guide into the question of how big data is applied across issues and domains and how it is valid and relevant to all of us today.

Keywords: Big data; policymaking; strategy; business; public policy; society

1. Introduction

Big data is a buzzword of our times, and yet the awareness of what big data is, how it permeates our daily lives, and how it is applied either in the policy-making process or in the business sector remains relatively low. From a different

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perspective, while specialists, that is, practitioners and researchers, dealing with the technical facets of big data successfully uncover new features, new domains, and new opportunities related to big data, there is a need of evaluating and examining these findings through the lens of social sciences and management (Visvizi et al., 2020). The challenge is that respective research communities, on the one hand, the computer science community, and on the other hand, social scientists and students of management, remain divided. It is thus important that connections, or bridges, are built that will allow these communities to enter a dialogue and seek synergies between their respective research agendas. This book responds to this plea by looking explicitly at the question of how big data is applied across issues and domains and how it is valid and relevant to all of us today.

This book derives from the understanding that big data and the supporting ecosystem of technologies, including blockchain and smart contracts, artificial intelligence (AI) and machine learning, internet of things (IoT), etc., and applications have a dramatic impact on the decision-making process (Corvello et al., 2021; Provost & Fawcett, 2013; Visvizi, 2022) across issues and domains, including politics, policies, and the business sector (Loebbecke & Picot, 2015; Visvizi & Bodziany, 2021). At the same time, the very nature of big data, a term originating in the computer science discourse, remains opaque to research communities more closely associated with social sciences and management. And yet, it is in the fields of research that these communities are engaged with that the impact of big data is pervasive (Chen et al., 2012; Wamba et al., 2015) and, hence, requires in-depth exploration. In other words, it is imperative to build bridges between the computer science-driven debate on big data and research taking place in social sciences and management (Visvizi et al., 2022). This book dwells on this multifaceted issue.

The objective of this book is to examine in which ways, that is, through which mechanisms and to what end, big data influences contemporary societies, and especially the processes of decision-making, strategy setting, and overall performance in such domains as politics, specific policy fields, and the business sector. The chapters included in this book have been divided into three parts. The chapters included in Part 1 seek to conceptualize big data and its value added for the society, including the big questions of privacy, safety, and security of big data and intra-municipality relations. In Part 2 through a careful analysis of selected case studies, including healthcare (Botti & Monda, 2020), hospitality, tourism (Li et al., 2018), and agri-food policy, an overview of big data and its application is offered. In Part 3, the focus of the discussion is directed at the business sector and the connection between big data and the efficiency of the decision-making process is discussed. Respective findings are examined critically.

The value added for this book is threefold, that is, first and foremost, this book queries the applied aspect of big data. For anyone who always knew big data as an abstract term, this book will be an eye-opener. In this way, this book may encourage new research in the field of social science on big data (Grimmer, 2015), its application, and related opportunities and caveats. Second, this book focuses on the question of how big data is integrated in the fabric of (public and private) institutions and organizations and how its value can be exploited. Third,

this book offers a critical appraisal of lessons learnt until now in the process of harnessing the promise inherent in big data.

2. The Structure of the Book and the Methodological Approach Adopted

The book has been divided into three parts dealing with diverse aspects of big data and its value added for the decision-making process and policymaking (Höchtl et al., 2016), in general. Part 1 contains chapters (Chapters 2–5) that deal with exploring the concepts and meaning attached to big data. By doing so, the chapters included in this part also highlight the value added of big data and the relevance of big data-driven approaches in today's world (Troisi, et al., 2020). Part 2 (Chapters 6–9) elaborates on diverse ways in which big data is applied across issues, domains, and policy fields. In this way, the topics discussed in this part of the book revolve around big data and its uses in healthcare (Dash et al., 2019), the agri-food sector, hospitality, and circular economy (CE). Part 3 (Chapters 10–13) deals with business and policy-making processes that are empowered by big data. The following topics are discussed: big data, CE, and the small- and medium-sized (SMEs) sector; smart organizations and big data, including the local government, cities, and smart cities.

The discussion throughout the book is embellished by references to case studies focusing on selected policy fields, for example, safety and security, healthcare, tourism, etc. Detailed and methodologically sound reviews of literature add to the depth of the discussion. The content of the book is inter- and multi-disciplinary, because to address the complex set of questions defining the objective of the book, a variety of insights originating in diverse fields of social sciences, including politics and international relations, as well as public policy, business and management, and at times computer science are employed. In other words, the discussion in this volume builds bridges across disciplines to navigate complex challenges that require multi-disciplinary approaches and methods. Indeed, the chapters included in this volume employ an array of conceptual approaches and methodological tools, always in line with the precepts of good science. Qualitative and quantitative research methods are applied. These are embedded in a variety of conceptual frameworks originating in social sciences, managerial research, and other.

3. Detailed Content of the Book

The discussion in the book opens with a discussion (Chapter 2) on the key concepts defining the broader debate on big data, on the caveats and on the challenges that beset the debate and the application of big data. To this end, the authors, Anna Visvizi, Orlando Troisi, and Mara Grimaldi, argue that the possibility to collect and analyze unprecedented quantities of data pertaining not only to the operation of private and public sectors, but also to the lives of individuals, bears the potential to employ the data as invaluable source of information, and possibly knowledge. The latter, in turn, may lead to innovation (Trabucchi & Buganza,

2018), and innovation-led sustainable growth and development of our societies (Dubey et al., 2019; Etzion & Aragon-Correa, 2016). Inasmuch as the promise inherent in – what tends to be termed – big data is huge, so are also the caveats related to the prospect of exploiting the benefits of big data. In this chapter, it is argued that four challenges beset the possibility of effective and efficient use of big data today. These include: a substantial degree of ignorance as to what big data actually is; the challenge of obtaining quality data; the challenge of the utilization of big data in the decision-making process; and, finally, the twin ethical and legal challenge pertaining to the acquisition and the use of big data. It is also argued that the awareness of the existence of these caveats enables a critical insight into the promise big data brings about for our societies today.

In Chapter 3, Giulia Leoni, Gennaro Maione, and Luca Mazzara, discuss performance measurement and management systems (PMMS) in the inter-municipal cooperation context by considering the development of new capabilities required to exploit the digital governance potentialities in which data integration is essential (Andrejevic, 2014). The analysis relied on the advent of digital governance, the Italian public informative systems reform, as well as on local governments renewals through the Union of Municipalities (UMs) – one of the most widespread structured forms of inter-municipal cooperation – based on the sustainability of local service delivery. Through a review of the literature and the conceptual outcomes resulting from the analysis of the dynamic capabilities theory applied to digital governance, this chapter aims at suggesting a useful contribution for an effective improvement of PMMS in the public sector networks, with the consequent improvement of resilience in policy management. Thus, the broad information required by the UMs and the complexity of its administration together with the constraints regarding the need to share a common vision and strategy, plan objectives, targets, measurement, and evaluation processes are considered. In particular, three propositions have been developed as guidelines for achieving coordination, coherence, and integration of measuring and managing performances in public networks. This evidence will offer insights allowing scholars and practitioners a practical understanding on whether and how dynamic capabilities – applied to digital governance – address PMMS challenges within an inter-municipal cooperative context.

In Chapter 4, the authors, Xhimi Hysa, Mario D'Arco, and Joana Kostaqi explore the question of the misuse of personal data in times of big data analytics. Specifically, this chapter explores young individuals' attitude toward protection of personal data. Specifically, the discussion focuses on the General Data Protection Regulation (GDPR) and the introduction of a property right over personal data. To this end, a total of 10 in-depth interviews were conducted with both Albanian and Italian college students. Transcribed data from the interviews were analyzed through thematic analysis. Four main themes emerged from the interviews: (i) distrust toward the way personal data are used online, (ii) no change in behavior after the introduction of GDPR, (iii) limited knowledge regarding terms and conditions of websites, and (iv) individual desire for more control over his/her data. In light of the research findings, the present contribution highlights

that, despite the GDPR enhances individuals' data protection and rights, there is an intention–behavior gap that has been labeled by extant literature as a "privacy paradox" (Jain et al., 2016). Furthermore, findings reveal that treating personal data as a property right has pros and cons.

Chapter 5, by Anastasija Nikiforova, Artjoms Daskevics, and Otmane Azeroual, offers a detailed insight into NoSQL security, with the key question addressed being: can my data-driven decision-making be affected from outside? As the authors stress, today, there are billions of interconnected devices forming Cyber-Physical Systems, IoT, and Industrial Internet of Things (IIoT) ecosystems. With an increasing number of devices and systems in use, amount, and the value of data, the risks of security breaches increase. One of these risks is posed by open data sources, by which are meant databases, which are not properly protected (Kitchin, 2014; Nikiforova, 2021). These poorly protected databases are accessible to external actors, which poses a serious risk to the data holder and the results of data-related activities such as analysis, forecasting, monitoring, decision-making, policy development, and the whole contemporary society. This chapter aims at examining the state of the security of open data databases representing both relational databases and NoSQL, with a particular focus on a later category.

In Chapter 6, Gianluca Maria Guazzo and Vilma Çekani investigate how big data influences the diffusion of knowledge in firms and how it influences the firm's innovation process. The chapter identifies gaps that exist in the current literature on the topic. This study is conducted by using a qualitative methodology. PRISMA methodology is used to carry out a systematic literature review. The results shown in this study indicate the positive influence that technology has on knowledge sharing and innovation and on the other hand how good management of knowledge can benefit SMEs. The limitation of this study is related to the methodology, whereas it is considered that a quantitative methodology can be incorporated into the other research resources. The chapter's aim is to fill a gap in the current literature and to be a new starting point for scholars and managers. Through this work, managers can better understand how to improve the innovation process through knowledge sharing in their organizations. The originality of the present study represents a first step in understanding the mechanisms of knowledge sharing within firms, how it supports the innovation process, and what role big data plays in this context.

In the context of the debate on the healthcare sector, Chapter 7, by Antonietta Megaro, addresses the question of transparency in AI-supported systems. The objective of this chapter is to offer an understanding of the role AI plays in value co-creation in healthcare service. It is argued that AI, as an operant resource, can stimulate a completely patient-centered, adaptive and resilient healthcare system, and governance models in healthcare based on data-driven decision-making, ensuring faster choices, more timely diagnoses, and more personalized treatment paths. However, the full implementation of AI in healthcare is inhibited by some frictions, mainly related to the risk that the AI black box may generate an inadequate automatic decision, also due to the quality of

data used, often partial and unstructured, given the reluctance to share them by patients concerned by privacy threats. The co-design (multi-part and multi-level) of a predictive decision model based on the functional transparency of the AI algorithm, would allow for augmented decision as result of an effective human–machine interaction. Healthcare actors could thus make decisions using the information detected by the software (based on clear cause-and-effect correlations and modifiable variables in case of mistakes), integrated with their professional knowledge. This would also help to strengthen the patient's perception of the decision's reliability and accuracy and the safety of the tool (factors that can affect his/her trust). AI may be considered as a driver for value co-creation in healthcare, thanks to transparency. It would allow the promotion of collaborative behaviors between involved actors by generating new institutions and new resource integration practices among them.

In Chapter 8, authored by Antonio Botti and Antonella Monda, big data's impact on tourism and entrepreneurship is examined. As the authors stress, the progressive increase in the size of the data present in datasets, the so-called big data, provides researchers with the opportunity to extract a greater amount of useful information in many sectors, especially for the tourism industry. This chapter demonstrates that sustainable tourism (ST) may be favored by using big data and a data-driven approach. Furthermore, as ST appears in line with a new type of responsible entrepreneurship, called Humane Entrepreneurship (HumEnt), this chapter investigates the link between ST and HumEnt and the impact of big data and data-oriented approaches on ST and HumEnt. The chapter analyzes these relationships using a qualitative approach and applying the case study technique. Findings show the advantages of the data-driven approach to tourism and entrepreneurship.

The authors of Chapter 9, Benedetta Esposito, Ornella Malandrino, Maria Rosaria Sessa, and Daniela Sica, explore the use of big data and digital technologies in context of the agri-food sector. It is argued that the improvement of the agri-food supply chain sustainability plays a pivotal role in the planet's survival and in overcoming climate disasters. Digital technologies that support the collection of Big Data produced along the agri-food supply chain emerge as powerful tools to accelerate the ecological transition of the sector. Digital technologies can support the implementation of circular business models by sharing data across the supply chain, monitoring in real-time the materials flow, automatizing some agricultural practices, and improving the decision-making through the development of decision support systems (Curry, 2016). Despite the relevance of these arguments, there is a lack of shared frameworks and guidelines for the effective development of a "data-driven circular economy" in the agri-food supply chain. In this scenario, the present study examines how scholars investigate data-oriented strategies to accelerate the ecological transition and the adoption of CE models in the agri-food sector. To this end, a systematic literature review was performed. Twenty-nine papers were selected following a rigorous sampling process. Both bibliometric and descriptive results are provided in the first part of the paper. According to the analytical framework developed, the selected papers

were examined through the lens of the "reduce, reuse, and recycle" (3R) paradigm. Moreover, an additional R was retrieved from the systematic review (i.e., redesign), broadening the analytical perspective. The results indicate that scholars have predominantly provided theoretical contributions concerning the role of digital technologies and big data for the agri-food circular transition from a macro perspective. The findings are useful for policymakers and managers, who can promote and implement the big data-oriented approach to facilitate the circular transition. Limitations and future research directions are also provided.

Chapter 10, by Radosław Malik and Katarzyna Rybkowska, employs the Science Mapping method to explore how the intersection of big data and the business process has been explored in the literature. Specifically, this chapter uses multiple research methods, including quantitative science-mapping analysis (SciMat) and a qualitative literature review, to provide insight into the academic debate unfolding at the intersection of big data and business processes. SciMat analysis based on keyword co-occurrence enabled identifying 12 of the most productive research themes, as reflected in a poll of 301 articles about big data and business processes. The three most important themes are: firm performance, Industry 4.0, and innovation. The traditional literature review on firm performance indicated that big data analytics positively influence business process performance and have a beneficial impact on a firm's performance, that is, the role of big data is viewed as critical in the context of Industry 4.0 because it enhances productivity and improves business processes. The benefits of big data analytics can be achieved only if the organizational obstacles related to planning, workforce attitude, and alignment with strategy are overcome. Moreover, big data is perceived as a significant source of innovation in an organization and can be conceptualized with the use of a resources-based view of the firm. Big data analytics positively influence business processes, which is strengthened by adequate implementation and openness to innovation.

In Chapter 11, by Anne-Mari Järvenpää, Jari Jussila, and Iivari Kunttu, the barriers and practical challenges for data-driven decision-making in CE SMEs are explored. It is argued that the CE model is seen as an alternative model to the linear economy models, which seem to be reaching their physical limits. The CE business model aims to reuse materials and decrease the need for virgin materials. This requires the implementation of a reverse supply chain, close collaboration between actors, as well as well-organized logistics. For this reason, the CE companies have typically high demand for digitalized processes and the utilization of data on both operational and business development dimensions. Also, the utilization of big data collected from the companies' business environment can provide new opportunities for business development in CE. Even though utilization of data collected from the business environment and operations enables data-driven approaches for various decision-making functions in companies, many companies still struggle to figure out how to use analytics to take advantage of their data. In the SMEs, the managers are facing difficulties with ever-increasing amounts of data and sophisticated analytics. Indeed, prior research identified several kinds of barriers to the effective utilization of data in SMEs. Still, research on data-driven

decision-making remains scarce in CE context. This paper presents a case study consisting of seven cases, all representing SMEs operating in the field of CE in Finland. In the case study, the barriers, and challenges for data-driven decision-making in CE SMEs are investigated. Based on the case study results, the paper proposes that utilization of data, lack of resources, lack of capabilities, and regulation are the main barriers to data-driven decision-making in CE SMEs.

Chapter 12, is authored by Francesca Loia. The key line of the argument is that the growing turbulence of the external environment has progressively led to the necessity by organizations of exploiting new opportunities (Troise et al., 2022). The new digital environment has led to the development and adoption of innovative approaches; also in the urban context which has always been characterized by different, interconnected, and dynamic dimensions. Urban governance models have been enhanced by smart technologies, which act as enablers of advanced services and foster connections between citizens, public and private organizations, and decision-makers. In this context, the objective of this chapter is to examine the role of data-driven approaches in the urban context during the chaotic and high variable circumstances related to the diffusion of the Covid-19 (Polese et al., 2022). Thanks to the adoption of the co-evolutionary perspective, a cycle in urban governance decision-making approach based on digital technologies is depicted and its contribution for managing the ongoing Covid-19 is traced. The results of the analysis highlight how the data-driven approach supports urban decision-making and shed light on the co-evolutionary perspective as a heuristic device to map the interactions settled in the networks between local governments, data-driven technologies, and citizens. In this sense, the study offers interesting insights, potentially capable of generating useful implications for both researchers and professionals in the public sector.

The discussion in the book closes with a chapter that showcases how big data may be useful in modeling and building a smart city. Chapter 13, authored by Olena Sokhatska and Ruslana Lutsiv, offers an in-depth insight into factors and processes necessary for a smart city development. In particular, the authors underline that the cities of the twenty-first century are becoming independent actors on the international scene. Due to decentralization, cities gradually gain more power to independently identify their policies, strategies and related priorities, as well as ways of their implementation. As a result, several initiatives can be implemented at the city level at a much faster pace and more efficiently than ever before. The United Nations' (UN) "Transforming our world: the 2030 Agenda for Sustainable Development" focuses on issues related to sustainable development. In relation to cities, it aims to make them "inclusive, safe, resilient and sustainable." This chapter investigates the conceptual foundations of the term smart sustainable cities and summarizes strategies that have been undertaken in cities, as a means of making them smart and sustainable. Against this backdrop, by focusing on Ukraine, an implementation algorithm based on selected examples drawn from Europe is proposed. Sadly, as the story accompanying this chapter proves, big data, algorithms, and the will to promote growth and development alone are not sufficient in a world where recourse to violence and breaches of international treaties are met with impunity. Note that the chapter was written