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Trends and Challenges in Digital Business Innovation

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ISBN 978-3-319-04306-7 ISBN 978-3-319-04307-4 (eBook)
DOI 10.1007/978-3-319-04307-4
Springer Cham Heidelberg New York Dordrecht London

Library of Congress Control Number: 2013958136

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Foreword

This book aims to improve the understanding of trends and challenges in digital business innovation at the European as well as at the global level. It helps create a connection between business readers and academic research. The book summarizes what is hot—each year—in digital business, but with a focus on showing something new to professionals from an academic perspective. In this book, Vincenzo has put together several topics, clustering them in three Parts that could be seen as the steps of a roadmap. The book focuses first on the main digital systems' trends (Part I), trying to examine technological issues such as Big Data, Cloud Computing, Mobile services, etc., from a managerial perspective, aiming to reach a wide spectrum of executives, including those without an IT background. These last two Chapters shift the perspective of Part I, introducing the reader to Part II, which analyses and discusses the managerial challenges of technological trends focusing on governance models, the transformation of work and collaboration as a consequence of the digitization of the work environment, and finally dealing with what may be considered the real challenge to digital business: how to manage, control, and exploit a company's identity and brand in a competitive digital environment. Part II frames the managerial challenges so that they can complement the IT manager's perspective, while providing a useful summary of the state of the art for other non-IT executives. Part III discusses how companies have carried out "innovation in practice", providing easy to read and structured forms on what were some of the more interesting experiences at a global level in 2013. It is a challenge for any scholar to identify the most popular digital business topics in any given year. Given this, summarizing the vast literature in information systems, digital marketing, and computer science and identifying the most cutting edge phenomena is an arduous task. I congratulate Vincenzo for this book and look forward to seeing it in print soon.

Anindya Ghose

Preface

This book aims to discuss and present the main trends and challenges in Digital Business Innovation to a composite audience of practitioners and scholars. Accordingly, each considered topic will be analyzed in its technical and managerial aspects, also through the use of case studies and examples, the book having two main objectives:

- to review and discuss recent digital trends emerging from both managerial and scientific literature. Furthermore, the book aims to summarize, compare, and comment challenges and approaches to business digital transformation of organization, being a simple yet ready to consult scientific toolbox for both managers and scholars;
- to be the first of a yearly outlook focused on digital trends emerging from both the managerial and scientific literature, supporting organizations to identify and take advantage of digital business innovation and transformation, as well as its related opportunities.

As for the review objective, it is yet challenging to find a unified survey of current scientific work concerning relevant topics to digital business innovation, such as, for example, the different perspectives of Information Systems research (from management to computer science and engineering, among others). Furthermore, it is yet difficult to find such kind of unified survey acting as an instrument for providing practitioners a perspective on academic research, suitable to be used by them in their day-to-day activities or simply as an update on what academia may offer with regard to the industry proposals. Notwithstanding some journals such as, e.g., MIT Sloan Management Review, IEEE Computer, or the Communications of the ACM (CACM) have such a mission of connecting research and industry practices, at the best of the author knowledge they do not provide a yearly integrated summary or critical review, encompassing their respective areas (management, engineering, and computer science). However, these publications are going to be a part of the large set of information and body of knowledge together with other journals such as, e.g., Management of Information Systems Quarterly (MISQ), Communications of the Association for Information Systems, Management of Information Systems Quarterly Executive (MISQE), Information Systems Research, European Journal of Information

Systems, Journal of Information Technology, Information Systems Journal, and conferences such as International Conferences of Information Systems (ICIS), European Conferences of Information Systems (ECIS), America's Conferences of Information Systems (AMCIS) (just to mention some of the Management of Information Systems research sources), that this book aims to consider for identifying the challenges, ideas, and trends, that may represent "food for thoughts" to practitioners.

Notwithstanding the book adopts an academic approach as for sources collection and analysis, it is also concrete, describing problems from the viewpoints of managers, further adopting a clear and easy-to-understand language, in order to capture the interests of top managers as well as graduates students.

Taking these issues into account, this book is distinctive for its intention to synthesize, compare, and comment major challenges and approaches to business digital transformation of organization, being a simple yet ready to consult scientific toolbox for both managers and scholars. Finally, as said above, the book aims to be the first of a yearly outlook focused on digital trends emerging from both the managerial and scientific literature. In what follows an outline of the book is provided.

Outline of the Book

The book argument is developed along three main axes. In particular, Part I first considers *Digital Systems Trends* issues related to the growing relevance, on the one hand, of *Big Data, Cloud Computing,* and *Mobile Services* for business; on the other hand, it discusses the drivers and challenges of *Social Listening* and *IT Consumerization*, topics of strategic interest for IT and Marketing executives, in order to enable an effective understanding of today's organizations as well as users behavior and needs. Thus, in this part of the book the main technological trends, actually debated in both academia and industry, will be discussed and analyzed in their managerial challenges and opportunities. The trends have been selected also on the basis of focus groups and interviews to 80 European IT executives from different industries (finance, manufacturing, utilities, service, among others). Focusing on systems evolution trends from a technology push perspective, the analysis will move from information and service infrastructure topics such as *Big Data* and *Cloud Computing*, through *Mobile Services* as platforms for socializing and "touch points" for customer experience, to emerging paradigms that actually are transforming marketing, governance, and the boundaries of organizations as well as our own private life (i.e., *Social listening* and *IT Consumerization*).

Subsequently, the Part II of this book considers *Digital Management Trends*, focusing on work practices, identity/brand digital transformation, and governance. In this Part, the analysis will focus on the main managerial trends, actually answering and reacting to the systems' trends surveyed in Part I. Also in this case the selected topics result both from academia and industry state-of-the-art analyses

and from focus groups and interviews to 80 European IT Executives from different industries (finance, manufacturing, utilities, and service, among others), likewise. Focusing on management evolution trends, the argumentation adopts a management pull perspective to consider how *work and collaboration* may be reconfigured or adapted to the new digital opportunities and constraints emerging from social networks paradigms, such as, e.g., crowdsourcing and people services. Moreover, this part of the volume will explore the identity challenges for businesses both as security and privacy issues; digital identity will be discussed also as with regard to brand management in the actual digital ecosystems, and the consequent constant revision of value propositions and business models for rebranding a company digital business, due to strict time to market. Furthermore, the last Chapter of this part of the volume will discuss the governance defies raised by the previous-mentioned changes and reconfiguration of organizational resources and structure.

Finally, Part III will discuss first (Chap. 9) the underlying issues and the most relevant concepts for understanding Business Model Innovation, providing general insights on the state-of-the-art and basic constructs of this research stream, suitable to support an understanding of its evolution in current digital business innovation experiences and practices. Then, Chap. 10 will present and review case studies of digital innovation trends at global level. Thus, the Chapter aims to discuss examples of digital innovation in practice, providing fact sheets suitable to build a "map" of the 10 most interesting digital innovations actually available worldwide. Besides an introduction to the factors considered in the choice of each innovation, a specific description of it will be developed. The considered 10 innovations will be discussed in their relationship to the topics of the previous Parts/Chapters, both providing insights on their potential evolution trends and unmatched characteristics, likewise. Finally, the conclusion will provide a summary of all arguments of the volume together with general managerial recommendations.

Vincenzo Morabito

Acknowledgments

This book is the result of a comprehensive research, where several people are worth to be acknowledged for their support, useful comments and cooperation. A special mention to Prof. Vincenzo Perrone at Bocconi University, Prof. Vallabh Sambamurthy, Eli Broad Professor at Michigan State University, and Prof. Franco Fontana at LUISS University as main inspiration and mentors.

Moreover, I acknowledge Prof. Giuseppe Soda, Head of the Department of Management and Technology at Bocconi University, and all the other colleagues at the Department, in particular Prof. Arnaldo Camuffo, Prof. Anna Grandori, Prof. Severino Salvemini, and Prof. Giuseppe Airoldi, all formerly at the Institute of Organization and Information Systems at Bocconi University, who have created a rich and rigorous research environment where I am proud to work.

I acknowledge also some colleagues from other universities with whom I've had the pleasure to work, whose conversations, comments, and presentations provided precious insights for this book: among others, Prof. Anindya Ghose at New York University's Leonard N. Stern School of Business, Prof. Vijay Gurbaxani at University of California Irvine, Prof. Saby Mitra at Georgia Institute of Technology, Prof. Ravi Bapna at University of Minnesota Carlson School of Management, George Westerman at MIT Center for Digital Business, Prof. Ritu Agarwal at Robert H. Smith School of Business, Prof. Lynda Applegate at Harvard Business School, Prof. Marco de Marco at Unversità Cattolica del Sacro Cuore di Milano, Tobias Kretschmer, Head of Institute for Strategy, Technology and Organization of Ludwig Maximilians University, Prof. Marinos Themistocleous at the Department of Digital Systems at University of Piraeus, Prof. Chiara Francalanci at Politecnico di Milano, Wolfgang König at Goethe University, Adriano Solidoro at University of Milano-Bicocca, Luca Giustiniano at LUISS University, Prof. Zahir Irani at Brunel Business School, Prof. Sinan Aral at NYU Stern School of Business, and Ken and Jane Laudon.

Furthermore, I want to gratefully acknowledge all the companies that have participated to the research interviews, case studies, and surveys. In particular, for the financial institutions: Banca Mediolanum, Banco Popolare, Banca Popolare dell'Emilia Romagna, Banca Popolare di Milano, Banca Popolare di Sondrio, Banca Popolare di Vicenza, Barclays, BCC Roma, BNL-BNP Paribas, Carige Group, Cariparma Credit Agricole, Cassa di Risparmio di Firenze, Cedacri, Che Banca!, Compass, Credito Emiliano, Deutsche Bank, Dexia, HypoVereinsbank,

ICBPI, ING Direct, Intesa Sanpaolo Group, IREN, Mediobanca, MPS Group, Poste Italiane Group, SEC, Société Européene de Banque, UBI Banca, Unicredit Group, Veneto Banca and WeBank. For the insurance sector: Allianz, Ergo Previdenza, Generali Group, Groupama, Poste Vita, Sara Assicurazioni, UGF Group and Vittoria Assicurazioni. For all other sectors: Acea, Aci Informatica, Amplifon, Anas, Angelini, ArcelorMittal, Armani, ATAC, ATM, Auchan, Autogrill, Autostrade per l'Italia, Avio, Baglioni Hotels, Barilla, Brembo, Chiesi Farmaceutici, CNH Industrial, Coca Cola HBC, Coop Italia, Costa Crociere, Danone, De Agostini, Diesel, Dimar, Dolce & Gabbana, Ducati, Edipower, Edison, Eni, Enel, ERG, Fastweb, Ferrari, Ferrero, Ferrovie dello Stato Group, Fiat Group, Finmeccanica Group, GlaxosmithKline, Grandi Navi Veloci, Gruppo Hera, Gtech, H3G, Il Sole24Ore, Kuwait Petroleum, Lamborghini, LBBW, Levi's, L'Oreal, Loro Piana, Luxottica Group, Magneti Marelli, Mapei, Marcegaglia, Messaggerie Libri, Miroglio, Oerlikon Graziano, Perfetti, Pirelli, Prysmian, Rolex, Saipem, Snam, Sorgenia, Telecom Italia, Terna, Unilever, Vodafone and Wind. For the public sector: Agenzia per l'Italia Digitale, Comune di Milano and Consip.

I would especially like to acknowledge all the people that have supported me during these years with insights and suggestions. I learned so much from them, and their ideas and competences have inspired my work: Silvio Fraternali, Paolo Cederle, Massimo Milanta, Massimo Schiattarella, Diego Donisi, Gianluca Pancaccini, Giovanni Damiani, Gianluigi Castelli, Salvatore Poloni, Milo Gusmeroli, Pierangelo Rigamonti, Danilo Augugliaro, Elvio Sonnino, Massimo Messina, Mario Collari, Massimo Castagnini, Pier Luigi Curcuruto, Giuseppe Dallona, Gilberto Ceresa, Jesus Marin Rodriguez, Fabio Momola, Rafael Lopez Rueda, Eike Wahl, Ruediger Schmidt, Marco Cecchella, Maria-Louise Arscott, Antonella Ambriola, Giovanni Sordello, Andrea Rigoni, Giovanni Rando Mazzarino, Silvio Sperzani, Samuele Sorato, Alfredo Montalbano, Gloria Gazzano, Massimo Basso Ricci, Giuseppe De Iaco, Riccardo Amidei, Davide Ferina, Massimo Ferriani, Cristina Bianchini, Dario Scagliotti, Ruggero Platolino, Ettore Corsi, Luciano Bartoli, Marco Ternelli, Alessandro Cucchi, Carlo Felice Ferrarini, Marco Tempra, Luca Ghirardi, Francesca Gandini, Vincenzo Tortis, Agostino Ragosa, Sandro Tucci, Vittorio Mondo, Enzo Bertolini, Roberto Fonso, Mario Bocca, Marco Zaccanti, Fabrizio Lugli, Marco Bertazzoni, Vittorio Boero, Jean-Claude Krieger, Maria Cristina Spagnoli, Alessandra Testa, Anna Miseferi, Carlo Brezigia, Mirco Carriglio, Matteo Attrovio, Nikos Angelopoulos, Paul Thysens, Luciano Romeo, Roberto Burlo, Gennaro Della Valle, Massimo Paltrinieri, Pierantonio Azzalini, Enzo Contento, Marco Fedi, Fiore Della Rosa, Carlo Capalbo, Simone Battiferri, Carlo di Lello, Gian Enrico Paglia, Fabrizio Virtuani, Luca Verducci, Luca Falco, Roberto Scolastici, Nicoletta Rocca, Mario Breuer, Marco Lanza, Marco Poggi, Giambattista Piacentini, Francesco Mastrandrea, Mauro Minenna, Massimo Romagnoli, Nicola Grassi, Gianni Leone, Domenico Casalino, Paolo Crovetti, Alberto Ricchiari, Alessandro Musumeci, Matthias Schlapp, Ugo Salvi, Danilo Gismondi, Patrick Vandenberghe, Guido Oppizzi, Alessandro Bruni, Marco Franzi, Guido Albertini, Vincenzo Russi, Diego Donisi, Fabio De Ferrari, Mauro Ferrari, Massimo Amato, Nunzio Calì, Gianfilippo Pandolfini, Cristiano Cannarsa,

Davide Carteri, Luca Terzaghi, Christian Altomare, Pasquale Tedesco, Ottavio Rigodanza, Lorenzo Pizzuti, Marcello Guerrini, Fabio Cestola, Alberto Alberini, Umberto Stefani, Elvira Fabrizio, Dario Pagani, Marino Vignati, Giuseppe Rossini, Renzo Di Antonio, Armando Gervasi, David Alfieri, Roberto Andreoli, Vincenzo Campana, Piera Fasoli, Alberto Grigoletto, Riccardo Scattaretico, Marco Ravasi, Mauro Viacava, Salvatore Stefanelli, Marco Zaffaroni, Giuseppe Langer, Daniele Rizzo, Massimiliano Gerli, Fabio Oggioni, Luca Severini, Roberto Conte, Nazzareno Gregori, Alessandro Campanini, Gabriella Serravalle, Giovanni Pietrobelli, Pietro Pacini, Stefano Firenze, Dario Castello, Michela Quitadamo, Francois De Brabant, Luciano Dalla Riva, Paolo Pecchiari, Francesco Donatelli, Massimo Palmieri, Riccardo Pagnanelli, Pierluigi Berlucchi, Raffaella Mastrofilippo, Davide Casagrande, Luca Martis, Stefano Levi, Patrizia Ferrari, Massimiliano Baga, Marco Campi, Laura Wegher, Diego Pogliani, Alessandra Grendele e Gianluca Pepino.

I would especially like to gratefully acknowledge Gianluigi Viscusi at EPFL-CDM-CSI, Alan Serrano-Rico at Brunel Univeristy, and Nadia Neytcheva Head of Research at the Business Technology Outlook (BTO) Research Program who have provided me valuable suggestions and precious support in the coordination of the production process of this book. Furthermore, I acknowledge the support of Business Technology Foundation (Fondazione Business Technology) and all the bright researchers at Business Technology Outlook (BTO) Research Program that have supported me in carrying out interviews, surveys, and data analysis: Florenzo Marra, Alessandro De Pace, Alessandro Scannapieco, Matteo Richiardi, Ezechiele Capitanio, Giulia Galimberti, Arianna Zago, Giovanni Roberto, Massimo Bellini, Tommaso Cenci, Marta Silvani, Giorgia Cattaneo Puppo, Andrada Comanac.

A special acknowledgement goes to the memory of Prof Antonino Intrieri who provided precious comments and suggestions throughout the years.

Finally I acknowledge my family whose constant support and patience made this book happen.

Vincenzo Morabito

Contents

Acronyms

ACID	Atomicity, Consistency, Isolation, and Durability
BM	Business Model
BMI	Business Model Innovation
BYOD	Bring Your Own Device
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIO	Chief Information Officer
CMMI	Capability Maturity Model Integration
COBIT	Control Objectives for Information and related Technology
COC	Cross Organizational Collaboration
CoP	Community of Practice
CRM	Customer Relationship Management
CSCW	Computer-Supported Cooperative Work
CSFs	Critical Success Factors
CxO	C-level Manager
DDS	Digital data stream
DMS	Document management system
ECM	Enterprise content management
HR	Human Resources
ICT	Information and Communication Technology
IPO	Initial public offering
IT	Information technology
ITIL	Information Technology Infrastructure Library
KPIs	Key Performance Indicators
NoSQL	Not Only SQL
R&D	Research and Development
SMEs	Small and medium enterprises
TOGAF	The Open Group Architecture Framework
VOIP	Voice over Internet Protocol

Part I
Digital Systems Trends

Chapter 1
Big Data

Abstract The role of this Chapter is to introduce the reader to the area of Big Data, one of the IT trends actually emerging as strategic for companies competing in current digital global market. The Chapter aims to clarify the main drivers and characteristics of Big Data, both at technical and managerial level. Furthermore, the Chapter aims at investigating management challenges and opportunities, identifying the main phases and actions of a Big Data lifecycle. Finally, the discussion of case studies concludes the Chapter, providing insights from practice on factors and strategic points of attention, suitable to support Big Data-driven decision making and operational performance.

1.1 Introduction

"Try to imagine your life without secrets" claimed the incipit of an article by Niv Ahituv appeared on the Communications of the ACM in 2001 [1]. The author preconized the advent of an Open Information Society as a consequence of higher costs of information protection, proliferation and diffusion of computer networks, unlimited access to information by individuals and organizations, no matter their being private or else public subjects. Once considered a futuristic vision, this change in society is actually a reality, at least for what concerns the availability and the volume of data archived, stored, and exchanged as a consequence of the

V. Morabito, *Trends and Challenges in Digital Business Innovation*,
DOI: 10.1007/978-3-319-04307-4_1,

information diffused, produced, and consumed through social networks and digital infrastructures.[1] However, we are facing a radical change, with a new breed of potential business leaders, users and consumers.

As pointed out by Bruce Horovitz on USA Today "the still-forming generation of young folks whose birth dates roughly begin around 1995, will be the technically savviest ever. Naming it, however, will require an unusual combination of science, art and, perhaps, luck" [2]. This Generation Z, as Horovitz called it [2], is made up of digital natives (born after 1995) who literally live and breathe of the information flows in social networks and potentially see the world as a big data repository to be exploited, adapted, and aggregated depending on their current needs. Digital Artifacts such as, e.g., Wii, iPad, iPod, among others, represent an artificial extension of their human being, allowing a seamless integration of the virtual world of social networks and playground as part of their own everyday life. They post everything on Facebook and they "makes a game out of everything" as said Brian Niccol chief marketing and innovation officer at Taco Bell, cited by Horovitz. Obviously, former generations make use of digital artifacts and social networks too, but they are not as dependent on them as a digital citizen may be, requiring code of conducts, rules, and right, likewise [3].

Generation Z represents the source and the target for what the Economist called a Data Deluge [4], and they are worth to be considered in order to clearly understand actual and future business challenges of the phenomenon called Big Data, a core component of the information infrastructure upon which our society is building its own open environment.[2]

[1] In the following we use *data* when we refer to raw, unstructured facts that need to be stored and processed by an information system, in order to be meaningful and useful for an agent (being human or else a machine). Whereas we call *information* the useful and meaningful output of information systems, being the data processed, organized, structured, and presented. Thus, adopting the General Definition of Information (GDI) we could define information "data + meaning" [35]. It is worth noting that computer based information systems are a specific type of information system and not exhaustive [36]. For a systematic survey on the different definitions, meanings and use of information we kindly refers the reader to [35, 37].

[2] Using an iPhone app to request money from a nearby Automatic Teller Machine (ATM), scanning the phone to retrieve the bill. This is an example of a Generation Z like evolution of ATM design towards a convergence with online and mobile banking, with a consequent change in the volume and variety of data to be managed by banks and financial services providers. Furthermore, it shows how, e.g., finance sector competition is facing the challenge of PayPal and Google Wallet diffusion and adoption by digital natives. "We think we'll attract a new client base, 35 and under, we didn't cater to before" said Thomas Ormseth, Senior Vice President of Wintrust Financial in an article appeared in July 2013 on Bloomberg Businessweek [38].

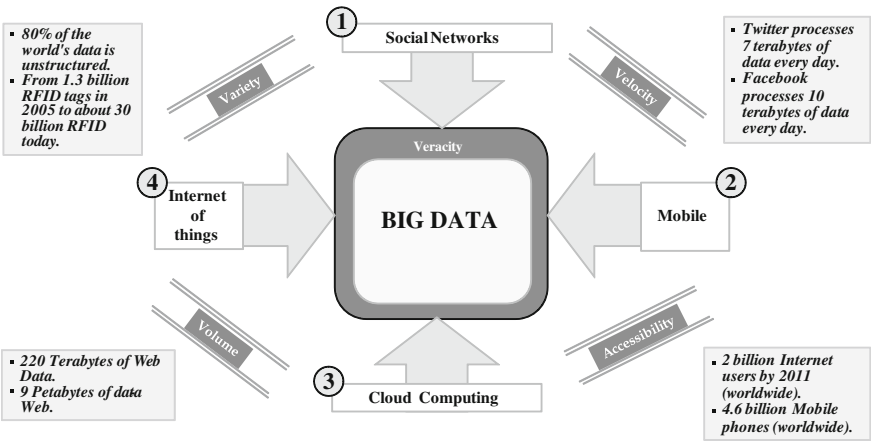

Fig. 1.1 Big data drivers and characteristics

1.1.1 Big Data Drivers and Characteristics

The spread of social media as a main driver for innovation of products and services and the increasing availability of unstructured data (images, video, audio, etc.) from sensors, cameras, digital devices for monitoring supply chains and stocking in warehouses (i.e., what is actually called *internet of things*), video conferencing systems and voice over IP (VOIP) systems, have contributed to an unmatched availability of information in rapid and constant growth in terms of volume. As a consequence of the above scenario, the term *"Big Data"* is dubbed to indicate the challenges associated with the emergence of data sets whose size and complexity require companies adopt new tools, and models for the management of information. Furthermore, Big Data require new capabilities [5] to control external and internal information flows, transforming them in strategic resources to define strategies for products and services that meet customers'needs, increasingly informed and demanding.

Thus, Big Data call for a radical change to business models and human resources in terms of information orientation and a unique valorization of a company information asset for investments and support for strategic decisions. Nevertheless, as usual with new concepts, also Big Data ask for a clarification of their characteristics and drivers. Figure 1.1 represents them, providing figures and examples, likewise.

At the state of the art the following four dimensions are recognized as characterizing Big Data [6–8]:

Volume: the first dimension concerns the unmatched quantity of data actually available and storable by businesses (terabytes or even petabytes), through the internet: for example, 12 terabytes of Tweets are created every day into improved product sentiment analysis [6].

Velocity: the second dimension concerns the dynamics of the volume of data, namely the time-sensitive nature of Big Data, as the speed of their creation and use is often (nearly) real-time. As pointed out by IBM, examples of value added exploitation of data streams concern the analysis of 5 million daily trade events created to identify potential fraud, or 500 million daily call detail records in real-time to predict customer switch.

Variety: the third dimension concerns type of data actually available. Besides, structured data traditionally managed by information systems in organizations, most of the new breed encompasses semi structured and even unstructured data, ranging from text, log files, audio, video, and images posted, e.g., on social networks to sensor data, click streams, e.g., from internet of things.

Accessibility: the fourth dimension concerns the unmatched availability of channels a business may increase and extend its own data and information asset.

It is worth noting that at the state of the art another dimension is actually considered relevant to Big Data characterization: ***Veracity*** concerns quality of data and trust of the data actually available at an incomparable degree of volume, velocity, and variety. Thus, this dimension is relevant to a strategic use of Big Data by businesses, extending in terms of scale and complexity the issues investigated by information quality scholars [9–11], for enterprise systems mostly relying on traditional relational data base management systems.

As for drivers, *cloud computing* is represented in Fig. 1.1, besides the above mentioned social networks, mobile technologies, and internet of things. It is worth noting that a priority number is associated to each driver, depending on its impact on one of the Big Data characteristics. As pointed out by Pospiech and Felden [7], at the state of the art, cloud computing is considered a key driver of Big Data, for the growing size of available data requires scalable database management systems (DBMS). However, cloud computing faces IT managers and architects the choice of either relying on commercial solutions (mostly expensive) or move beyond relational database technology, thus, identifying novel data management systems for cloud infrastructures [12, 13]. Accordingly, at the state of art *NoSQL* (Not Only SQL)[3] data storage systems have been emerging, usually not requiring fixed table schemas and not fully complying nor satisfying the traditional ACID (Atomicity, Consistency, Isolation, e Durability) properties. Among the programming paradigms for processing, generating, and analyzing large data sets, *MapReduce*[4] and

[3] Several classifications of the NoSQL databases have been proposed in literature [39]. Here we mention *Key-/Value-Stores* (a map/dictionary allows clients to insert and request values per key) and *Column-Oriented databases* (data are stored and processed by column instead of row). An example of the former is *Amazon's Dynamo;* whereas *HBase*, *Google's Bigtable*, and *Cassandra* represent *Column-Oriented databases*. For further details we refer the reader to [39, 40].

[4] MapReduce exploit, on the one hand, (i) a *map function*, specified by the user to process a key/value pair and to generate a set of intermediate key/value pairs; on the other hand, (ii) a *reduce function* that merges all intermediate values associated with the same intermediate key [41].

the open source computing framework Hadoop have received a growing interest and adoption in both industry and academia.[5]

Considering *velocity*, there is a debate in academia about considering Big Data as encompassing both data "stocks" and "flows" [14]. For example, at the state of the art Piccoli and Pigni [15] propose to distinguish the elements of *digital data streams* (DDSs) from "big data"; the latter concerning static data that can be mined for insight. Whereas *digital data streams* (DDSs) are "dynamically evolving sources of data changing over time that have the potential to spur real-time action" [15]. Thus, DDSs refer to streams of real-time information by mobile devices and internet of things, that have to be "captured" and analyzed real-time, provided or not they are stored as "Big Data".

The types of use of "big" DDSs may be classified according to the ones Davenport et al. [14] have pointed out for Big Data applications to information flows:

- *Support customer-facing processes*: e.g., to identify fraud or medical patients health risk.
- *Continuous process monitoring*: e.g., to identify variations in costumer sentiments towards a brand or a specific product/service or to exploit sensor data to detect the need for intervention on jet engines, data centers machines, extraction pump, etc.
- *Explore network relationships* on, e.g., Linkedin, Facebook, and Twitter to identify potential threats or opportunities related to human resources, customers, competitors, etc.

As a consequence, we believe that the distinction between DDSs and Big Data is useful to point out a difference in scope and target of decision making, and analytic activities, depending on the business goals and the type of action required. Indeed, while DDSs may be suitable to be used for marketing and operations issues, such as, e.g., customer experience management in mobile services, Big Data refer to the information asset an organization is actually able to archive, manage and exploit for decision making, strategy definition and business innovation [8].

Having emphasized the specificity of DDS, that will be further considered in the Chapters of this book dedicated to mobile services and social listening, we now focus on Big Data applications.

As shown in Fig. 1.2 they cover many industries, spanning from finance (banks and insurance), e.g., improving risk analysis and fraud management, to utility and manufacturing, with a focus on information provided by sensors and internet of things for improved quality control, operations or plants performance, and energy

(Footnote 4 continued)
MapReduce has been used to rewrite the production indexing system that produces the data structures used for the Google web search service [41].

[5] See for example how IBM has exploited/integrated Hadoop [42].

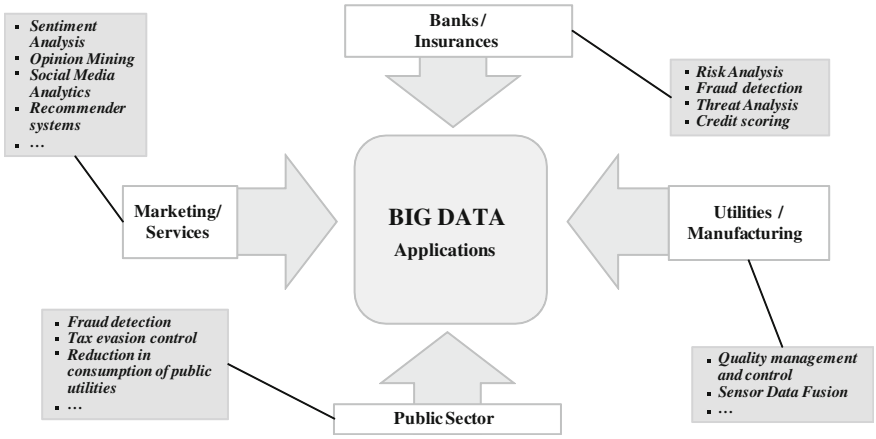

Fig. 1.2 Big data applications

management. Moreover, marketing and service may exploit Big Data for increasing customer experience, through the adoption of social media analytics focused on sentiment analysis, opinion mining, and recommender systems (for details we refer the reader to the Chap. 4).

As for public sector, Big Data represent an opportunity, on the one hand, e.g., for improving fraud detection as tax evasion control through the integration of a large number of public administration databases; on the other hand, for accountability and transparency of government and administrative activities, due to i) the increasing relevance and diffusion of *open data* initiatives, making accessible and available large public administration data sets for further elaboration by constituencies [16, 17], and ii) participation of citizens to the policy making process, thanks to the shift of many government digital initiatives towards an open government perspective [18–21].

Thus, Big Data seem to have a strategic value for organizations in many industries, confirming the claim by Andrew McAfee and Erik Brynjolfsson [8] that data-driven decisions are better decisions, relying on evidence of (an unmatched amount of) facts rather than intuition by experts or individuals. Nevertheless, we believe that management challenges and opportunities of Big Data need for further discussion and analyses, the state of the art currently privileging their technical facets and characteristics.

In the following Section, we actually would try to provide some arguments for understanding Big Data value from a business and management point of view.

Table 1.1 Big data perspectives and related actions

Perspectives	Types	Actions
Technical-data-provisioning	Technological	Storage
Technical-data-utilization	Technological	Use
Functional-data-provisioning	Business	Management
Functional-data-utilization	Business	Use

Elaboration from [7]

1.1.2 Management Challenges and Opportunities

In the Sect. 1.1.1 we have provided a set of drivers and characteristics actually identifying Big Data and their target applications. However, they do not allow yet a clear understanding of the specific actions required for exploiting their research and business value with regard to traditional information management problems. Indeed, on the one hand, as pointed out by Pospiech and Felden [7], Big Data seems to be yet another *brick in the wall* in the long discussion in the information systems field on information supply to decision makers and operations in enterprise. On the other hand, Big Data change the rules of the game, asking to change the overall *information orientation* [22] of an organization (from the separation of stocks and flows, to the need for paying an integrated and real-time attention to them).

Thus, Big Data are different because they actually prompt a rethinking of assumptions about relationships and roles of business and IT, moving information management and analytics from IT units to core business [14]. Accordingly, Big Data change decision making and human resources with regard to *capabilities* satisfying it, integrating programming, mathematical, statistical skills along with business acumen, creativity in interpreting data and effective communication of the results [5, 8, 14]. Therefore, Big Data challenges can actually be addressed by actions asking a technological/functional or else a business perspective, depending on the skills required by the specific task to be held. As for these issues, Pospiech and Felden [7] identified clusters of the main perspectives resulting from a state of the art analysis on, e.g., information systems and computer science, among other fields, contributions to Big Data research. In Table 1.1 we classify these perspectives with regard to their type and we associate actions they may be suitable to support in Big Data value exploitation.

Considering, the technological type of perspective, the *Technical-Data-Provisioning* classification mainly concerns *storage* related actions with regards to database management systems performance, in particular, as for scalability and query performance. On the contrary, the *Technical-Data-Utilization* classification addresses computational complexity issues related to both *provision* and *use* actions. As for the business type of perspectives, it is worth noting that they provide the management complement to challenges and actions that technological perspective is faced with. Whereas the *Functional-Data-Provisioning* one, mainly concerns approaches for the management of the data "deluge" [4], leading to an advanced information demand analysis and improved information supply [7].

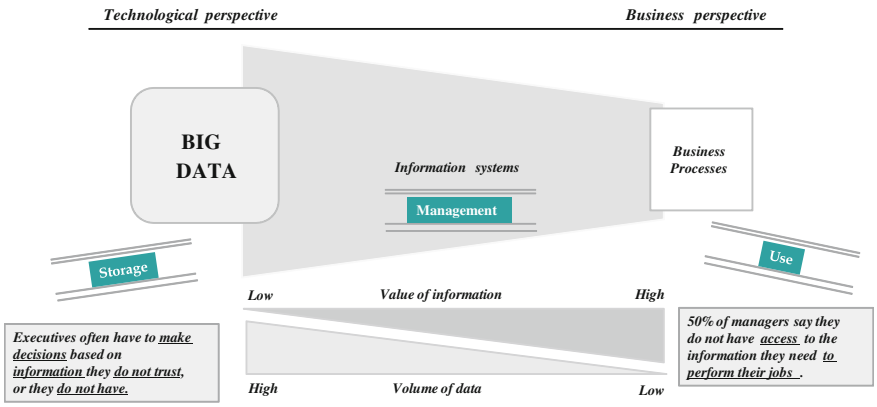

Fig. 1.3 Big data management challenges. Adapted from [7]

Thus, this may be seen as a management of information systems perspective, governing the overall lifecycle from Big Data storage to use. Nevertheless, the latter is suitable to be addressed with a *Functional-Data-Utilization* perspective, exploiting lessons learned and experience in the usage of Big Data from state of the art in various disciplines such as, e.g., social sciences, finance, bioinformatics, and climate science, among others [7].

Considering now the actions required for exploiting Big Data value, Fig. 1.3 provides a summary of the priority ones together with the related perspective (being technological, business, or information system oriented), and the management challenges they have to provide answers and solutions. Priority actions in Fig. 1.3 structure a lifecycle, starting from the (continuous) *storage* of data from the outer and inner flood involving today's organizations. Here, the challenge concerns the fact that executives often argue that they have to make decisions based on information they do not trust or they do not have. As pointed out by Tallon [23], managers have insights on value of data for their organization from profits, revenues, recovery costs derived by critical data loss or inaccessibility. As a consequence they have to assess their information asset to decide about retaining, searching, acquiring new data and to invest on storage technology. Indeed, the value of data and information they allow to produce in the information lifecycle curve, change depending on its currency and the usefulness in business processes and decision making [23, 24].

As shown in Fig. 1.3, the value of information augments with the positive impacts it has on business processes. In this case, the volume of data is reduced to a limited view on the asset actually stored in databases. Thus, having a very large volume of data does not imply that it provides valuable information to an organization's business processes or to decision making. Besides storage, companies need actions for Big Data management for (i) valuing information asset, (ii) understanding costs, (iii) improving data governance practices to extract the right data [23], (iv) providing useful information to demanding business processes and decision making.

Table 1.2 Data governance enablers and inhibitors

Factors	Enablers	Inhibitors
Organization	Highly focused business strategy	Complex mix of products and services
	IT/Strategy alignment	IT/Strategy misalignment
	Centralized organization structure	Decentralized organization structure
Industry	Regulations	Regulations variance by region (US, EU, etc.)
	Predictable rate of data growth	Absence of industry-wide data standards
Technology	Culture of promoting strategic use of IT	Data hoarding
	Standardization	Weak integration of legacy IT systems

Adapted from [23]

As for data governance, several approaches have been proposed in the literature for Data Quality Management (DQM) to face strategic and operational challenges with quality of corporate data [25]. Accordingly, scholars in the research areas of information systems and information quality have identified a set of enabling and inhibiting factors for effective data governance. In Table 1.2 we show the ones highlighted by Tallon [23] for implementing data governance practices suitable to support valuable Big Data management.

The factors considered in Table 1.2 act at organization, industry, and technology level, showing the enabling role of alignment, centralization, standardization, and strategic use of IT orientation. Nevertheless, these enablers being quite recognized in theory and practice as a good management of information systems target, on the other hand, they look as by far challenging, due to the distributed nature of Big Data and the unpredictable dynamics of the digital environment producing them. Furthermore, they often require business process management and optimization to get the target performance levels [26].

Thus, it is worth to be considered the advice by Awargal and Weill [27] that due to the increasing volatility of business environment, by building strategy around business process optimization issues, organization may fail to exploit Big Data. Indeed, optimization often leads to rigidity and inflexibility of business processes, instead of the agility expected by dynamic information flows.

Accordingly, we believe that a useful approach to management and use of Big Data is what Awargal and Weill [27] called *softscaling*, requiring three core capabilities for companies and their IT units to act as enabling factors for an "empatic" use of information for value creation. Softscaling allows companies to rely and exploit Big Data to develop flexible strategy and business models, thus, anticipating and responding to volatility of market and customer needs, while having efficient and sustainable business processes. Figure 1.4 shows these capabilities, i.e.:

- ***optimizing business processes*** and technology for operational excellence;
- ***creating emotional ties*** and connections for an improved focus on customer needs and experience;

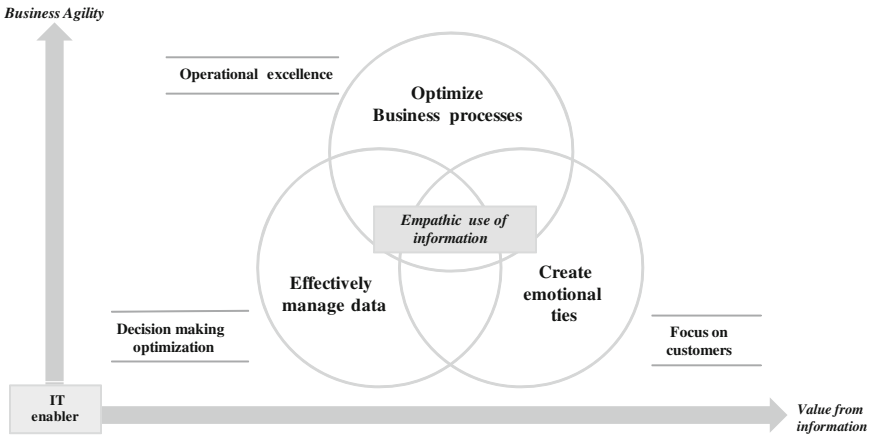

Fig. 1.4 Empathic use of information for value creation: actions and targets of IT as enabling factor

- ***managing effectively data***, supporting time-to market and evidence-driven decision making.

Furthermore, companies aiming to exploit the opportunities offered by Big Data have to connect business agility to information value (axes in Fig. 1.4), through informed empathy. The latter meaning to contextualize data sources, improving data access to customers, employees, and value-chain partners, further cultivating emotional connections [27]. An example, is the case described by Awargal and Weill [27] of the use of demographics made by Hero MotoCorp. This New Dehli based manufacturer of motorcycles and scooters integrated its Customer Relationship Management (CRM) with contextual data on young women customer experience entering India's workforce. Thus, Hero MotoCorp has been able to promptly answer to their local concerns about shopping and driving moto scooters, by designing new products and initiatives, such as, e.g., showrooms staffed by women, with private curtain where trying the scooters and judge how they look on them.

The above arguments and cases lead us to the third Big Data lifecycle challenge. As for their *use*, as seen above, companies has to rely on new data management technologies and analytics to get evidence of facts rather than intuition by experts or individuals. However, as shown by Lavalle et al. [28] in a research on more than 3,000 business executives in 108 countries and more than 30 industries, top performing organizations use analytics both to guide future strategies (45 % vs. 20 % of low performers) and day-to-day operations (53 % vs. 27 % of low performers).

In particular, low performers resulted more oriented towards the use of intuition than top performers in customer service, product research and development, general management, risk management, customer experience management, brand

management, and workforce planning and allocation. Furthermore, Lavalle et al. [28] pointed out that among the impediments to becoming data driven, companies answer the following main issues:

- lack of understanding of how to use analytics to improve the business;
- lack of management bandwidth;
- lack of skills internally in the line of business.

Accordingly, organizations involved in the Lavalle et al. [28] survey expected that *data visualization* techniques are worth to become the most valuable in the next years, when combined with analytics applied to business processes. Notwithstanding these techniques support a better understanding of how to use analytics to improve the business, we believe that the actual lack of skills require, first, a change in human resources and talent management towards an information orientation of the overall organization capabilities, and a consequent internal diffusion of data scientists among the employees [5].

In addition, it is worth noting that data were not considered by interviewees among the main impediments to a full exploitation of Big Data opportunities to business value. However, managers considered as a priority or mandatory premise for their organization to have their data asset characterized by high degree of integration, consistency, standardization and trustworthiness. Thus, we can summarize the main challenges and IT actions of Big Data for business value as follows:

- ***Convergence of information sources***: IT in the organization must enable the construction of a "data asset" from internal and external sources, unique, integrated and of quality.
- ***Data architecture***: IT must support the storage and enable the extraction of valuable information from structured, semi-structured as well as unstructured data (images, recordings, etc.).
- ***Information infrastructure***: IT must define models and adopt techniques for allowing modular and flexible access to information and analysis of data across the enterprise. Furthermore, organizations must commit human resources in recruiting and empowering data scientist skills and capabilities across business lines and management.
- ***Investments***: The IT and the business executives must share decisions on the budget for the management and innovation of information assets.

Taking these issues into account, we can now provide a comprehensive representation of the factors and actions described in previous section to support the maintenance, exploitation, and evolution of Big Data as key part of the digital asset of today's organizations.

To this end, Fig. 1.5 shows how digital asset components, i.e., IT portfolio and the data asset of an organization, actually are also determined by external data, applications, and services due to the growing relevance of social networks, mobile services, and technology/paradigms such as cloud computing (we provide further details on each of them in Chaps. 2, 3 and 4, respectively).

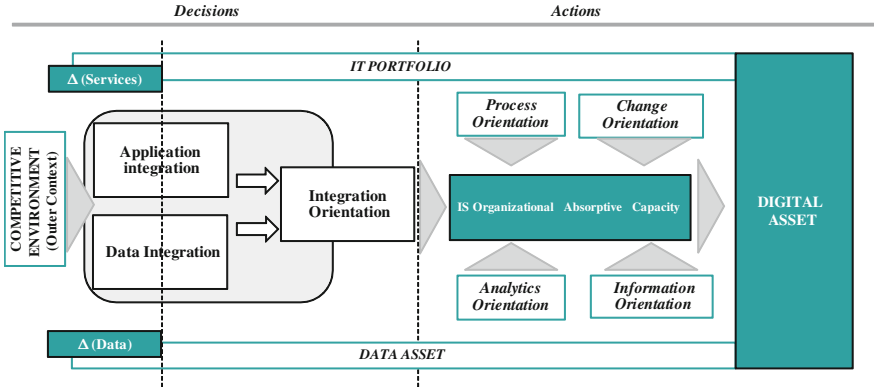

Fig. 1.5 A framework for managing digital asset

As a consequence, the competitive environment and the outer context both represent the main Big Data sources, alimenting in a volatile and dynamic way the digital asset of an organization, which has to be managed by internal information systems likewise. As shown in, Fig. 1.5, both business decisions and actions rely on the digital asset of an organization, although requiring different types of orientation in managing the information systems (IS). As for decisions, *integration orientation* seems to be required for satisfying the needs for optimization and effective data management of Big Data. Indeed, the greater the integration of a company's information system, the faster the overall planning and control cycles [29].

Applying to Big Data issues the SIGMA model, that we have proposed in a previous work to improve strategic information governance modeling and assessment [29], we argue that integration orientation refers to IS integration and is determined by two variables, *application integration* and *data integration* (see also [29, 30]). Accordingly, integration orientation constitutes a fundamental lever of both analytic, information, and process orientation, facilitating the absorption and transformation of information and knowledge into evidence-driven actions, helping managers decision making and employees perform their work.

Thus, integration orientation is one of the determinants of organizational absorptive capacity, which, in turn, is theorized to affect business performance [29, 30]. Indeed, *absorptive capacity* measures the ability of an organization to complete a learning process as coping with IT complexity or in our case with Big Data management and use by businesses. As a consequence, moving from decisions to actions call for an organization to improve *IS absorptive capacity* [29, 30] in terms of the set of key orientations considered in the above mentioned SIGMA approach: analytics, information, process, and change orientation. Considering these issues, we point out that the framework in Fig. 1.5 is suitable to provide a systemic and integrated "working" representation of factors and drivers involved in managing digital assets, which aim to exploit the opportunities of Big Data for business performance and value.

Table 1.3 Factors, recommendations, and strategy points for big data lifecycle phases

Lifecycle phase	Factors	Recommendations	Strategy points
Storage	Technology	Consolidate corporate databases (internal) and integrate new information sources (internal/external)	Completeness
Storage	Technology	Identify and store relevant data from all information sources (internal/external)	Relevance
Management	Technology	Adopt analytics appropriate to the volume, variety, and velocity of data (real-time)	Timeliness and accuracy
Management	Industry/ Organization	Establish clear goals and articulate a vision coherent with market opportunities, effectively engaging customers, employees and other relevant stakeholders	Leadership
Management	Organization	Investments in human resources with a mix of new analytical skills and business	Talent management
Management	Organization	Implement a decentralized approach, and diffuse collaborative and transparent use of information	Organizational culture
Use	Technology	Adopt data visualization tools and manipulate data with real-time tools	Timeliness/ Simplification
Use	Organization	Ensure access to information and an appropriate level of decision-making autonomy at all levels of the company	Accountability

Taking all the contributions discussed in this section into account, Table 1.3 summarizes a set of strategy points and recommendations for managerial actions in building what we call a *Big Data intelligence agenda*. It is worth noting that a relevant factor and challenge has to be considered as the background to the agenda and to most of the issues considered in this book: *privacy* and *identity* management for businesses and individuals as well.

Nonetheless, due to their extensiveness, we have decided to treat these issues in Chap. 7 dedicated to Digital Business Identity. Finally, in conclusion of this Chapter we would like to submit to the attention of the reader a set of case studies, providing him with insights from practice as well.

1.2 Case Studies

In this Section we discuss fact-sheets of case studies, which illustrate at a glance how strategy points for Big Data lifecycle phases in Table 1.3 have been addressed in practice, emphasizing point of attention and insights for managers.

The first case study shows the relevance of having a clear business strategy aligned with IS strategy for Big Data exploitation from social media. The case has been discussed by Moses et al. [31] and concerns The Minnesota Wild, an ice hockey team based in St. Paul, Minnesota, United States, members of the Central Division of the Western Conference, of the National Hockey League (NHL). The Minnesota Wild Hockey Club has developed a social media strategy strongly aligned with its business strategy, focused on three key objectives: to increase sales of subscriptions, to promote the sale of tickets among casual fans, and to increase advertising revenue.

In 2010, the club has launched its social program, using mainly Facebook and Twitter, and the ability of these platforms to provide data that can translate user choices in demographic information valuable to achieve marketing and communications initiatives, thus, maximizing the involvement of consumers and therefore the interest of sponsors.

POINT OF ATTENTION: Hockey Club has managed to build and transform a wide and varied volume of digital interactions in satisfactory results in terms of market share and profit.

The second case study has been analyzed by Sharma et al. [32], and shows the relevance of having a clear strategy aimed to consolidate and integrate internal and external data sources through appropriate storage and data warehouse technologies. Bahrti Airtel operates in the Indian mobile market characterized by constant growth. In such a context, to remain competitive, companies must implement strategies geared to reach and engage a broad spectrum of potential customers with lifestyle, culture and income very different between them. Indeed, for all groups of consumers, even the most mature (concentrated in large cities and industrial areas), the locus of competition has shifted from the price of the service to the satisfaction of the specific needs of customers: time to market is critical to respond quickly to consumer trends, satisfying the needs of differentiated groups of consumer. Thus, data are the main asset for evidence-driven decision making.

The claim *"Our objective is to have one version of the truth!"* by Rupinder Goel, CIO of Bharti Airtel Limited, summarize the need for a single set of data that include finance, marketing, customer service, as a way to know its customers 'needs, experience, and lifestyles.

POINT OF ATTENTION: Using Big Data should be enhanced and supported by a business strategy focused and shared by the overall company functions and processes. The analysis and the production of reports have to be outsourced with caution and should not be bound by formal standards that might reduce its effectiveness in the short and long term.

As a consequence, Baharti Airtel, to manage the evolution of the market, has created an IT infrastructure, including data warehouse systems aimed at the collection and subsequent analysis of data from various corporate activities. The production and use of information reports were introduced gradually in the company, up to in-house solutions aimed at the production of ad hoc reports for strategic value.

The third case study, based on a Cloudera case history [33], focuses again on the relevance of consolidation and integration for retrieving valuable information from Big Data, with a specific attention to data base technologies. The case analyzes how Nokia, the Finland based global telecommunications company, has faced with these challenges. Indeed, effective collection and use of data is strategic to Nokia for understanding and improvement of users' experiences with their phones and other location products/services. Nokia leverages data processing and analytics to build maps with predictive traffic and layered elevation models, information on points of interest around the world, and to monitor and assess the quality of its mobile phones, among other issues.

Considering the case study, Nokia aimed to have a holistic view on people interactions with different applications around the world, requiring an infrastructure that could support daily, terabyte-scale streams of unstructured data from phones in use, services, log files, and other sources. The challenge has been to integrate its silos of applications, enabling a comprehensive version of truth from data captured at global level. Furthermore, Nokia had to face the cost of capturing petabyte-scale data using relational databases. As a consequence, the choice has been to build an information infrastructure based on a technology ecosystem, including a Teradata enterprise data warehouse, Oracle and MySQL data marts, visualization technologies, and Hadoop at the core of Nokia's infrastructure.

POINT OF ATTENTION: Big Data ask for a clear understanding of both IT Portfolio and data asset, for identifying relevant data from all information sources (internal/external) to be stored, and for a savvy and sustainable choice of the right mix of technologies to consolidate corporate databases (internal) and integrate new information sources (internal/external).

As reported by Cloudera [33] the centralized Hadoop cluster actually contains 0.5 PB of data. The resulting infrastructure allows data access to Nokia's employees (more than 60,000), and efficiently moving of data from, for example, servers in Singapore to a Hadoop cluster in the UK data center.

Nevertheless, Nokia faced also the problem of fitting unstructured data into a relational schema before it can be loaded into the system, requiring extra data processing step that slows ingestion, creates latency and may eliminates important elements of the data. The solution has been found in Cloudera's Distribution that includes Apache Hadoop (CDH), bundling the most popular open source projects

in the Apache Hadoop stack into a single, integrated package. In 2011, Nokia put its central CDH cluster into production to serve as the company's information core.

Finally, we present a case study that shows how a Big Data strategy can be implemented in a specific industry. The case is based on a Consultancy case history [34] and shows how General Electric Co. (GE), the US based utility corporation, is building Big Data and analytics capabilities for an "Industrial Internet".

In 2011, GE announced $1 billion investment to build software and expertise on Big Data analytics, launching a global software center in San Ramon, California. GE charged William Ruh from Cisco Systems to lead the center, developing software and data science capabilities for GE's Big Data domain of interest ('the industrial Internet').

POINT OF ATTENTION: Big Data require top management commitment and investments, in particular, on human resources to be focused on data scientist capabilities. Furthermore, talent management and employees retention have to be considered as a core target for the success of a Big Data strategy.

As argued by Consultancy [34], GE envisions Big Data as a $30 trillion opportunity by 2030, using a conservative 1 % savings in five sectors that buy its machinery (aviation, power, healthcare, rail, and oil and gas), estimating the savings from an industrial Internet for these sectors alone could be nearly $300 billion in the next 15 years. In particular, Big Data is strategic for a growing percentage of GE's business related to services, such as, e.g., supporting its industrial products and helping customers use GE's machines more effectively and efficiently. Indeed, the GE assesses the success of software and analytics by their enabling a new portfolio of compelling service offerings, helping, e.g., airlines, electric utilities, hospitals to exploit GE's Big Data expertise, generating big savings, likewise. Thus, human resources and talent management are key issues to GE Big Data strategy.

The center has a staff of about 300 employees (most of them, characterized as "hardcore data scientists"), located in San Ramon and around the globe, as well (Bangalore, New York, and Cambridge), reporting into the center. The center organizes employees into reference disciplines, such as, e.g., machine learning, statistics, and operations research, among others. Furthermore, centralization of the staff is motivated by three factors: an acute shortage of talent, having in-depth data science and deep analytics capabilities; a consequent need for employee retention; reusability in technology.[6]

[6] *"The reason is you can't find the talent, you can't maintain it, and so on. We believe this idea of reuse is going to differentiate the winners from the losers."* Ruh, reported by Consultancy (2013).

1.3 Summary

In this Chapter, we have discussed the business challenges of Big Data as a core component of the information infrastructure upon which our society is building its own open environment. Often referred as an IT trend, the Chapter has clarified the main drivers and characteristics of Big Data, both at technical and managerial level, emphasizing their differences with regards to, e.g., *digital data streams* (DDSs); the latter referring to streams of real-time information by mobile devices and internet of things, that have to be "captured" and analyzed real-time, provided or not they are stored as "Big Data". Furthermore, we have investigated management challenges and opportunities, identifying the main phases and actions of a Big Data lifecycle. As for these issues, the Chapter has pointed out the relevance of "softscaling" approaches, balancing optimization issues, such as, e.g., integration and standardization of the information infrastructure, and an attention to experience and contextual needs for an empathic exploitation of Big Data as a digital asset.

Finally, the Chapter has discussed a set of case studies, confirming the importance of a clear and shared Big Data strategy together with investments and focus on human resources for capabilities, suitable to support Big Data-driven decision making and operational performance.

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