BUSINESS ADMINISTRATION AND ACCOUNTING STUDIES

MARISA AGOSTINI - DARIA ARKHIPOVA

BIG DATA AND ANALYTICS IN ACCOUNTING

Theories, regulations and implications

G. Giappichelli Editore

22

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La pubblicazione di una monografia nella Collana è subordinata al verificarsi di due circostanze:

a) accettazione della proposta editoriale presentata dall'autore/i secondo il formato definitivo dalla collana;
b) ottenimento di un giudizio positivo sul volume da parte di due revisori anonimi.

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Introduction

Digital technologies such as big data analytics (BDA) are being increasingly used by businesses to create economic and societal value (Ferraris *et al.*, 2019; Constantiou and Kallinikos, 2015; Günther *et al.*, 2017; Rana *et al.*, 2023). As a consequence, academic literature has emphasised their "disruptive potential" for enhancing corporate sustainability performance (Etzion and Aragon-Correa, 2015), creating more equal and inclusive society (Secundo *et al.*, 2017), fostering optimal reallocation of underutilized resources (Etter *et al.*, 2019) and enabling more participatory and democratic forms of governance (Neu *et al.*, 2019; Ojala *et al.*, 2019; Uldam, 2018).

Conversely, the advocates of the critical approach have raised concerns about digital technologies related to privacy and security threats (La Torre *et al.*, 2018), limitations of autonomy and freedom (Andrew and Baker, 2019), labour exploitation (Fuchs, 2010), lack of algorithmic accountability (Martin, 2019), pervasive worker control (Chai and Scully, 2019), and ecological footprint (Corbett, 2018; Lucivero, 2020). Hence, the magnitude and pervasiveness of ethical, social and environmental risks that emerge as a consequence of user data collection, storage and algorithmic processing are imposing additional responsibility upon data processing companies. To this end, the extant literature offers three main reasons for why large technology companies still lack accountability for these consequences. First, the problem resides in the inherent power asymmetries between the companies and individual users that pre-empt the latter from holding the former accountable for their wrongdoings (Rosenblat and Stark, 2016; West, 2019). Such quasi-monopolistic concentration of power in the hands of internet corporations is exerted not only vis-a-vis individual consumers but also other organisations (i.e., suppliers, competitors) whose business survival depends on the services of the large companies (Flyverbom *et al.*, 2019). Second, regulatory efforts in the data economy often take place post hoc (Nunan and Di Domenico, 2017) and do not adequately address the contemporary issues of digitalization (Royakkers *et al.*, 2018). Until recently, a self-regulatory regime prevailed in technology regulation based on "soft" voluntary standards and principles which the large companies devel-

oped for themselves. Finally, wrongful practices become pervasive to the extent that the other actors take them for granted and stop questioning them (Ananny and Crawford, 2018).

As a result, companies find themselves in a "dual" position in which they simultaneously need to harness the potential of BDA to generate economic and societal value on the one hand, while at the same time are required establish an effective mechanism for ensuring accountability for the negative consequences of data utilization on the other. Hence, from the accounting perspective, this raises three important questions as to (1) whether accounting scholars can explain the emergent issues with BDA using established accounting theories, (2) whether and, if so, how the processing of BD results in calls for wider organisational accountability and greater regulatory oversight and (3) how the value of BDA can be assessed from a financial accounting standpoint. The present manuscript aims to address these questions.

Chapter 1 "Emerging technologies in accounting" reviews technologies that underlie the use of BDA in accounting, provide definitions, discuss their interdependencies and explain differences between different technologies, illustrating their current and potential applications. In particular, new sources of big data and their characteristics will be discussed; different analytical approaches will be reviewed. The principal goal of this chapter is to establish a clear terminology and introduce key concepts that are fundamental for understanding the role of BDA in accounting.

Chapter 2 "Peculiar and established theories framing studies of BDA in accounting" examines whether and how accounting literature has rooted BDA issues inside theoretical frameworks in order to formulate new concepts and models, to support the adoption of further methods and approaches, to explain and root the solutions used in practice.

Chapter 3 "Data Regulations in the European Union" provides the most recent overview of the legal frameworks and regulatory developments in the European Union with regards to the data collection, use, storage, processing and sharing. Starting with the General Data Protection Regulation (GDPR) implementation in 2018, the European Union is taking a pioneer role in data-related regulations globally, imposes greater obligations, stricter rules and accountability frameworks. The chapter provides business and competitive context to explains the nature of the problem each regulatory initiative seeks to address, provides a general overview of the legal provisions in the context of the theoretical research in law, information systems and accounting and concludes by critical assessment of the effectiveness of the regulation – enforced or proposed – in reaching its goals and formulates a series of recommendations for potential improvement.

Chapter 4 “Assessing the Value of Big Data and Analytics: Issues, Opportunities and Challenges” assesses the value of data that derives, rather than from inherent conditions, from the possibility of generating insights and the actual use of the same (Ferraris *et al.*, 2019; Günther *et al.*, 2017).

“Conclusion” summarizes key research findings useful to provide answers to the above listed three research questions.

1.
Emerging technologies in accounting

Big data analytics (BDA) facilitates data collection, processing, information delivery and managerial decision making (Sardi *et al.*, 2020; Bhimani and Willcocks, 2014; Rikhardson and Yigitbasioglu, 2018). Traditionally, companies used to collect financial and non-financial data generated as a result of customer transactions or recorded as a by-product of their ongoing operational activity. The data was intentionally collected by companies for known purpose, organised in a tabular form, and stored on local servers. Information delivery implied reporting of past results which were analysed periodically; analytics was predominantly descriptive in nature and oriented towards the past. By contrast, digitalisation has unlocked new data sources (social media, Internet-of-Things), collection (mobile connectivity, online platforms), storage (cloud-based infrastructures), processing (artificial intelligence and machine learning) and information delivery (real-time interactive dashboards and sector-specific software) capabilities.

However, BDA does not exist in isolation. Instead, it is enabled by the ever-increasing use of connected mobile devices and automatic data generation by means of exchange between connected devices and human online interactions on social media platforms, underpinned by advanced network infrastructures, supported by cloud-based data storage, processing and computing, and analysed by advanced machine learning algorithms. Therefore, before turning to theorizing about BDA, reviewing its regulatory developments and managerial implications, it is important to identify technologies related to BDA and clarify the relationships between them. Doing so will establish a common vocabulary and provide a clear set of technology-related terms which can be drawn upon when discussing their implications for accounting theory, regulation and practice. The following terms are reviewed: (1) mobile and connectivity, (2) big data, (3) artificial intelligence and machine learning, (4) cloud, (5) data security, (6) Internet-of-Things, and (5) online platforms and social media.

Mobile is an umbrella term used for the family of technologies that run on

portable devices that are equipped with wireless connectivity capabilities. Mobile connectivity allows their users to access, send and receive data and information without being restricted to a particular physical location. The ubiquity of mobile devices opens new opportunities for continuous data collection and gaining valuable consumer insight as well as information on operational efficiency and workforce performance but also creates additional risks for privacy and security.

Big data (BD) is a term that defines complex and extremely large datasets that emanate from multiple, different sources and require advanced capabilities for collection, storage and processing because of their volume, variety and velocity. BD comes from three major sources: (1) data recorded as a result of operating activity of an organisation (e.g., transactional data), (2) data generated by individuals as a result of their online activities (e.g., social media posts) and (3) data generated automatically by connected devices (e.g., machine-generated data in smart devices) (Andrew and Baker, 2021). What distinguishes BD from other organisational resources that it can be shared and reused by multiple businesses simultaneously or sequentially without diminishing its economic value (von Ditfurth and Leineman, 2022). **Big data analytics** (BDA) refers to the process of extracting useful information from the BD using advanced algorithms.

Artificial intelligence (AI) encompasses a range of "intelligent" algorithms that are capable of learning and improving their performance over time. AI systems learn from the input data: the more observations are fed into the learning algorithm, the better the system gets at predicting a particular outcome. A distinction is often made between code-driven and learning-based AI (Smuha, 2021a). While both are based on algorithms, the former includes rule-based techniques that instruct the algorithms "top-down", the latter AI systems – referred to as **machine-learning (ML)** – rely on large amounts of data to 'learn' patterns in data and improve automatically by learning through experience (Smuha, 2021a). Because the ML algorithms learn autonomously, they are referred to as opaque "black-boxes" that are prone to amplify bias in the data and produce discriminatory outcomes which are not detectable by human intervention.

Cloud relates to the hardware and software capabilities (e.g., servers, storage, networks) provided "as-a-service" over the Internet by third-party suppliers such as Amazon Web Services or Microsoft Azure. BDA requires a powerful IT infrastructure and sufficient computational power to analyse large, unstructured datasets and deliver results in real-time. Relying on cloud technology results in significant cost savings as it reduces the need to make large IT capital investments and eliminates the costs of maintenance and local storage but raises questions about excessive dependence on the cloud service provider and raises security concerns (Yigitbasioglu, 2015).

Data security breach incidents can be categorised using confidentiality, integrity and availability (CIA) triad (La Torre *et al.*, 2018). *Confidentiality* refers to the ability to protect personal information from being viewed or accessed by an unauthorized party. An example of confidentiality breach occurs when personal data is revealed to the public. However, the original data remains intact and in full control of an organisation that stores it. *Integrity* refers to the ability to protect the personal data from being modified or deleted without authorization. Data integrity violations may occur as a result of intentional external security attacks (La Torre *et al.*, 2018) as well as undesirable actions by authorized personnel (Nunan and Di Domenico, 2017). The example of loss of integrity is when personal data records are altered, and the damage is exacerbated in situations when the fact of data tampering is not immediately apparent to the user. Finally, *availability* refers to the ability to provide continuous access to data. Availability may be comprised because of the power outrage, data theft or malicious attacks. As a result, it becomes impossible to retrieve personal data (Arkhipova and Vaia, 2018).

Internet of Things (IoT) refers to a connected network of "smart" devices – consumer electronics, industrial equipment, etc. – that can receive, send and exchange data over the Internet. Such devices are embedded with sensor technology, network connectivity and software applications and can be remotely controlled by a human or interact with one another automatically. As physical products become commoditised, gaining access to IoT-generated data to create better offerings and new data-driven business models is imperative for creating and sustaining competitive advantage.

Platforms connect distinct customer groups in two- or multi-sided markets and provide an intermediation service that enables interactions between different types of user groups (Podzun and Bongartz, 2021). Platforms share a set of characteristics. First, platforms benefit from substantial scale economies and network effects that result in a quasi-monopoly power on the market (Podzun and Bongartz, 2021). Second, platforms act as a "dual agent" for both sides of the market which can lead to structural conflict of interest (von Ditfurth and Leineman, 2022). Third, platforms often exert full control over data collection on both sides of the transaction, which in some cases may lead them to compete with their own users. Finally, social media platforms have recently drawn attention because of algorithmic recommendations design which resulted in user preference manipulation and propagation of mis- and disinformation (Heldt, 2022).

In sum, BDA is underpinned by a set of complementary technologies and serves as an enabler for new business models and other technologies that build upon BDA.

2.
Peculiar and established theories framing studies of big data analytics in accounting

2.1. Introduction

This current era is considered the age of Big Data (BD), the impact of which has been considered disruptive to various organisations, industries and economies (Oesterreich and Teuteberg, 2019), and described using expressions such as "management revolution" (McAfee *et al.*, 2012), "the next frontier" (Manyika *et al.*, 2011) and "extreme velocity of change" (Bhimani and Willcocks, 2014). BD's economic power to transform and reconfigure the economy has been assimilated to the internet's advent (Agarwal and Dhar, 2014) because it has proven able to modify procedures, establish new businesses, facilitate market entry, attract new clients and alter social dynamics and users' skills (Lucas *et al.*, 2013). As described in previous chapters, the BD phenomenon implies that data are continuously generated at unprecedented rates and velocities across organisations of all types and industries (Mikalef *et al.*, 2018). Therefore, the collection, analysis and control of large and complex data sets resulting from such a variety of sources require advanced techniques and technologies (Chen *et al.*, 2012), generally called Big Data Analytics (BDA). BDA implementation is complex but useful for recognising insights and identifying connections from massive amounts of data to improve decisions and judgments (John Walker, 2014; Oesterreich and Teuteberg, 2019).

The revolution brought about by the advent of BD and the attention gained by BDA have also had an impact on accounting research, giving rise to new issues, opportunities and challenges (Griffin and Wright, 2015; Vasarhelyi *et al.*, 2015). On the one hand, from the opportunities' perspective, accounting research can be based on unconventional and innovative datasets providing further evidence and leading empirical archival research in accounting to advance to a higher level. This potential improvement is related to both the vari-

ety of data sources and the increased access to data sets (unavailable until recently) from governments and other institutions (Warren *et al.*, 2015). On the other hand, from the challenges' perspective, there still seems to be a lack of theoretical foundation and practical understanding of the value of BD and BDA for companies (Mikalef *et al.*, 2019). Indeed, there has been an increase in the number of companies deciding to invest in BDA, but the actions to be taken to create an objective value that can be measured and reported remain ambiguous and unsettled (Munir *et al.*, 2022). BDA implies a rethinking process about the nature and classification of reality, the methods implemented in research, the potential connections with information and the construction of knowledge. This represents a real epistemological revolution (boyd and Crawford, 2012) for which accounting is changing and will probably continue to evolve (Leitner-Hanetseder *et al.*, 2021; Napier, 2006). The BD epistemological revolution still needs to be investigated because the data-driven approach, which is currently implemented by most BDA studies, is exactly the opposite of the traditionally adopted scientific epistemological perspectives on accounting (La Torre *et al.*, 2018; McAbee *et al.*, 2017). The epistemological revolution has gone so far as to question whether data can ground and frame theory (Cong and Du, 2022).

Accounting theories have traditionally been used to formulate new concepts and models, to support the adoption of further methods and approaches and to explain and root the solutions used in practice. As explained above, the development and application of BD and BDA in accounting are quite recent phenomena. Indeed, recent years have seen growing attention paid to how BDA might change accounting (Bhimani and Willcocks, 2014; Chapman *et al.*, 2021; Quattrone, 2016; Warren *et al.*, 2015), but this area of research is still fragmented and at an early stage in terms of theoretical grounding, methodological diversity and empirical analysis (Frizzo-Barker *et al.*, 2016). The aim of this chapter is to contribute to the understanding of BDA development and application in accounting, especially by analysing its theoretical frameworks.

In this way, the work aims to illustrate the role of accounting in BDA development and answers the following research questions: Upon what theories are BDA accounting studies based? What factors determining BDA development are identified as fundamental by accounting theories?

The first part of the chapter, which is presented in the next paragraph, recalls and discusses traditional research and theoretical perspectives concerning accounting information systems and technology. The analysis approach adopted for their introduction, based on the three main levels (i.e., calculation, information and knowledge, in Varaldo, 1990), evokes the current evolution

adopted to address the revolution introduced by BDA. The second part of this chapter is based on an analysis of the literature using and relating to accounting theories. The chapter is carried out in light of established accounting theories; its aim is to contribute to the understanding of BDA's impact on accounting studies in light of such theories.

2.2. Accounting information systems and technology: traditional and innovative theoretical perspectives

The use of the term "informatics" (*informatique*) dates back to 1962, when it was introduced for the first time by a French informatics pioneer, Philippe Dreyfus. This neologism derived from the combination of two terms: 'information' and 'automatic', highlighting the attention paid by the first computer scientists and the role played by the design and construction of calculating machines for the production of information. Indeed, the French Academy defined informatics as the science aimed at the rational processing of information through the use of automatic machines, capable of supporting human knowledge and communication in the technical, economic and social fields. Similarly, Frizzi (1977) defined the discipline in Italy dealing with the automatic processing of information using computers as "informatics". Even though informatics as a discipline included research areas of a theoretical nature that were not strictly related to the use of the computer, it coincided with automatic data processing or what was referred to by Anglo-Saxon term as computer science (Vallerani, 1982). As early as the late 1960s, it was realised that the *ex-ante* design of computers was not sufficient in itself and also required adequate *ex-post* programming: programmes had to be written, understood, corrected and only then executed by machines. This progressively led to the argument that informatics "has little to do with computers" (Abelson and Sussman, 1996). Computers brought about a revolution in the human way of thinking and expressing thought: it was an epochal and profoundly innovative phenomenon, which involved the emergence of procedural epistemology. The IT revolution also affected accounting (Varaldo, 1990). New ways of data processing became an important object of investigations in accounting research and were considered instrumental for the tasks performed by an accounting function within an organisation, such as systematic collection of useful information, its rapid classification and storage, organisational control, evaluating effects of organisation choices on the business system as well as for guiding managerial decision-making choices (Frizzi, 1977). The development of accounting systems into modern computer processing, in particular, consti-

tuted a relevant technical-professional issue, which also had a major impact on the evolution of the accounting profession (Coronella *et al.*, 2019). In particular, accounting scholars explore the history of the predecessors of Excel spreadsheets which are widely used by accounting professionals nowadays (Schmidt *et al.*, 2020a, 2020b). Galassi and Mattessich (2014) trace the emergence of a spreadsheet back to 1961 when Richard Mattessich has first introduced the concept of the computerised spreadsheets for budgeting process simulation in his article in The Accounting Review (Mattessich, 1961) which has laid down a foundation for developing a spreadsheet-based computer program for macro-computers using FORTRAN programming language. In 1969, Rene Pardo and Remy Landau present an electronic spreadsheet application for budgeting (called LANPAR) used in companies such as AT&T, Bell and General Motors. The first commercialised spreadsheet application for Apple personal computer – named Visicalc – was developed in 1978 by Dan Bricklin and Robert Frankston and become a pioneer innovation that set an example for subsequent spreadsheet application development (Galassi and Mattessich, 2014). Multiplan by Microsoft (a precursor to Excel) and Lotus-1-2-3 by the Lotus Development corporation were introduced in 1982 and 1983, respectively. The two spreadsheet applications remained fierce competitors till the introduction of Excel by Microsoft for Windows personal computer in 1985, after which the demand for Lotus applications began to decline. While several competing applications were introduced in the market subsequently (Quattro Pro by Borland Corporation), over 90% of the spreadsheet applications belonged to Microsoft Excel which were continuously improved in terms of functionality in the 1990s (Galassi and Mattessich, 2014). This evolution started from the need to connect accounting with system dynamics in order to develop models capable of reproducing observed firms and simulating different scenarios from alternative decisions. In particular, Mattessich (1958, 1961) argued that, if managed appropriately, the budget can serve as the foundation for the firm's economic and financial development simulation. Accounting began to be considered part of the management science due to the mental effort made by accountants in absorbing the tools and techniques of management doctrine and incorporating them into their conceptual apparatus. This needed interaction between different disciplines (i.e., management, computer science and accounting) has traditionally been analysed through three main levels focusing on calculation, information and knowledge respectively (Varaldo, 1990).

The first phase of analysis (i.e., calculation) focuses on improving the accounting process through the efficiency of the machine. As early as the 1960s,

with the aforementioned introduction of information technology, businesses found themself operating in a context characterised by the increasingly widespread adoption of advanced technological methods and tools. The computer, and more generally the technologies, became tools to facilitate man's work: technical progress called for the incessant development of information processing and transmission tools considered capable of increasing the productivity of man's mental work and consequently generating significant changes (Saraceno, 1978). The Italian doctrine of accounting have experienced a certain influence from the American doctrine that promoted the mechanisation of routine within an organisation through monotonous and repetitive tasks resulting in reduction of labor costs. According to Frizzi (1977), mechanisation enabled streamlining, optimization and standartisation of administrative processes across an organisation and facilitated (also improving) the preparation of accounting documents both for internal and third-party use. Furthermore, mechanisation of administrative work allowed to obtain labor cost savings without incurring large-scale upfront and operating cost of innovations (e.g., a new plant). Notwithstanding these advantages, mechanisation also proved to have certain limitations. First, although mechanisation provided quantitative data for facilitating paperwork, it contributed little to improve and inform managerial decision-making. Second, mechanisation of a subset of administrative processes implied that some procedures have continued to be performed manually, inevitably resulting in human errors, subjective interpretations, manipulations and distortions. Finally, mechanisation of a limited set of procedures resulted in initial disillusionment of upper management as they realised that the full benefits of mechanisation can have been only achieved if procedures automatically interacted and were integrated with one another, thereby forcing managers to review their approach. The latter point supported the view that an efficient "system" of accounting information was not based on automation of individual processes but, instead, united automated procedures into a single structure. The same management processes aimed at determining and regulating business systems were progressively qualified by the scientific approach, the adoption of refined techniques and the use of sophisticated tools for calculating, processing and transmitting information (Caramiello, 1966). The aim was to provide useful data to decision-makers at all levels of the organisational hierarchy in a timely manner and in the most appropriate form to the organisation function for which it was intended (Frizzi, 1977).

Indeed, the second phase (i.e., information) concerns the finalisation of the data elaborated by the machine to the decision-making process, requiring data

evaluation with respect to the corporate objectives (Rugiadini, 1970). In this respect, the term 'data' refers to the set of facts that represent events relating to a company or its surrounding environment system before they are organised in an intelligible and usable form for cognitive purposes (Culasso, 2004). On the other hand, the term 'information' refers to a set of data processed to be used by the corporate decision-making process for different cognitive purposes. Data is the elementary unit of information and must be subject to elaborative or aggregative processes in order to be exploited in the decision-making process (Sciarelli, 1999). Information must be understood not as any news or data acquired in a mediated or immediate way, but as new knowledge obtained through communication or sought through a direct process of observation. In other words, not all data communicated or acquired constitute information, but only those among them that increase the wealth of knowledge of those who receive or search for them become such. Indeed, the word information comes from the Latin *in formare* and literally means to give shape to something that has no form. Therefore, information is essential in order to move from the availability of data to the making of a business decision. Every individual – at whatever level he or she operates in the enterprise – needs information input in order to be able to choose the most appropriate behaviour from the possible alternatives in their decision-making process (Rugiadini, 1970). For this reason, Italian accounting scholars have been traditionally interested in the cost, risk and legal implications of installing an accounting information system in organisations. First, Frizzi (1977) mentioned that accounting information system requires installation of an electronic system with certain technical features that allow good memory capacity and fast access time to information. Managers also entrusted the computer with the simulation of special equipment designs and carried out energy analysis or auditing to optimize the operations of high-tech industrial plants and avoid significant energy losses (Vallerani, 1982). Doing so constitutes a fixed cost per company, which will be expensed only in the medium term, after the set-up is completed and permits an adequate economic use of the system (Frizzi, 1977). To that end, the role of certified public accountants was crucial as they were approached by the clients considering to install the system and were tasked with analysing its costs and benefits, advising smaller and medium enterprises in particular (Vallerani, 1982). Moreover, an important topic relates to the security and proper functioning of information system and the costs associated with having an acceptable level of risk of the system. Chiusa (1987) distinguishes between physical and logical security of information systems. While physical security refers to defence against events caused by the nature and human actions that result in hardware destruction, damage or physical access

of unauthorized outsiders to computer infrastructure, logical security deals with events that result in alternation of programs, input data or archives, violation of confidentiality of information transmitted online. To contain these risks within acceptable limits, managers must adopt appropriate defence measures and perform cost-benefit analysis to identify the magnitude of the cost involved in developing and implementing a measure, compared with the share of losses it is capable of avoiding (Chiusa, 1987). In sum, safety must strike a balance with efficiency: any increase in risks related to information system and its increased reach or functionality leads to an increase in costs and, consequently, decreasing the economic viability of investments. Finally – and related to the earlier point – the progress of information technology is so rapid that it causes uncertainties and unpredictable reactions (Vallerani, 1982) which complicates creation of legislation in the technology domain. On the one hand, the legal norm must apply over time, and the legislators should perceive the future trends in the development of information technology in different areas, which is almost impossible both because of the speed of the transformations taking place and because of the law-making mechanism itself. On the other hand, if legislators wait for information technology to yield certain, predictable and stable results over time, there is no doubt that the resulting legislation will be developed and adopted too late (Vallerani, 1982). The "information perspective of accounting" has represented a debate rooted in the academic literature and has traditionally aroused great interest (Cilloni, 1998, 1999, 2004; Galassi, 1987, 1991, 1994; Vigano and Mattessich, 2007).

An integrated information system within an organisation should entail a continuous and coordinated flow of information, which must be collected, analysed and transmitted to all individuals operating in the organisational structure. The promise of an integrated accounting system has encouraged accounting scholars to envision posterior control over management performance and results to be replaced by real-time analysis, prediction and prevention of negative outcomes. As long ago as in 1977, accounting information systems were viewed as an informatics tool that would enable managers to make the most of available information, and use past information to guide future decision-making, anticipate possible problems and develop solutions in advance. They were initially considered in their instrumental sense as sets of technical means and organisational structure underpinning a process (Sackman, 1967). In this regard, accountants become the ones who know the new electronic tools of information processing, masters their language and uses the computer economically, regarding it as a new factor of production system (Frizzi, 1977). Accountants possess cultural and scientific preparation that allow them to be

very apt in capturing the insights generated by the information systems and understand their concrete implications for business processes (Vallerani, 1982). The range of applications and techniques have expanded and have become increasingly complicated and sophisticated over the years both in the area of computers (hardware) and programs (software). In particular, accounting application software and programs were developed for solving particular managerial problems such as simplified accounting, VAT compliance management, IRPEF compliance management, payroll processing, warehouse management, production control and techniques for budgeting (Vallerani, 1982). To that end, a certified public accountant was engaged by the clients in order to analyse costs and benefits of employing a computer-based information system in a company. In doing so, accountant started by defining the problem and the objectives that the information system was intended to achieve (e.g., automating warehouse management), analysed the existing procedures and the existing system, then examined and implemented the technical features and functionality of the new system, and finally advises in the practical implementation of the new system and for its maintenance and reliability. Moreover, accountants often assumed the role of a programmer who prepared a set of instructions in a given programming language (BASIC, FORTRAN) and then translated these instructions by a special conversion program that is supplied to the processor for the purpose of obtaining a set of processes aimed at achieving the managerial objectives (Vallerani, 1982). It is noteworthy that the chartered accountants in professional firms not only acted as advisors for the companies that used computer-based information systems but were also direct users of these systems which they used to apply special procedures such as drafting and printing of company reports (financial and non-financial) and to provide up-to-date information on civil and tax regulations to clients. Therefore, the combination of mathematical, economic and accountancy knowledge and business experience of chartered accountants enable them from the very start of information technology development – recall the punch cards and perforated bands – to understand and assimilate the problems of information technology and study their practical applications (Vallerani, 1982). In this way, accounting information systems have been conceived from the outset as systems that permeate the entire company and cannot be attributed to a limited portion of the organisation. Information is elaborated and used throughout the entire company, from the strategic top management down to the most operational levels. Given its importance, numerous definitions of accounting information systems have been provided in the academic literature, which have also reflected the evolution of the interaction between IT and accounting. Giving more emphasis to its content and purpose, the information system was

considered as the set of information prepared to meet internal and external knowledge demands (Rugiadini, 1970). The need for it to be based on a set of procedures capable of enabling the realisation and transmission of information flows was progressively highlighted (Amaduzzi, 1972). The information system thus came to be configured as an ordered set of items, even very different from each other, designed to facilitate the collection, processing, exchange and storage of data with the aim of producing and distributing information at the right time and in the right place to the people in the company who needed it (Camussone, 1985). The most recent significant definitions highlight both the purpose of the information system and the procedure that leads from data to information through proper consideration of relationships and information needs. Therefore, the information system is considered the set of elements and their relations that guide the procedures for gathering information. These procedures, starting from the data that originally describe corporate and contextual phenomena, aim at satisfying, with effectiveness and efficiency, the company's internal and external knowledge needs (Marchi, 2003). Therefore, while accounting scholars have acknowledged the importance of logical-mathematical data processing for decision-making, they are also confident that human judgement, intuition and imagination remain key and conclude that success of information technology and management control is not possible without human insight and accounting knowledge (Frizzi, 1977).

2.3. Methodology, analysis and results

To examine whether and how the literature has rooted BDA issues inside theoretical frameworks, the current study is built on a review of the academic literature, searching the Scopus database and following a consecutive-steps approach [1]. First, three main keywords concerning BDA and theories in the accounting field were used to identify relevant pieces of literature through the Scopus database. Then, the works selected on the basis of such bibliographic research were further examined according to a specific review protocol based on the following three criteria:

– *document type*, selecting articles printed or already accepted (for print) by

[1] The following search criteria were used in the Scopus database (i.e., official website of Elsevier. URL: https://www.elsevier.com/solutions/scopus/why-choose-scopus): TITLE-ABS-KEY ('big AND data' OR analytic AND account* AND theor*) AND (LIMIT-TO (SUBJAREA, "BUSI")) AND (LIMIT-TO (DOCTYPE, "ar")). The search and the final sample were updated to November 4, 2022.

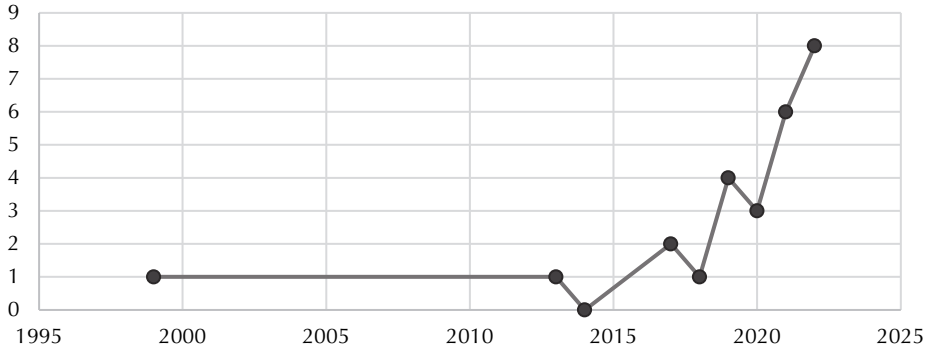
scientific journals to implicitly assess the quality of the sampled contributions;
– *language*, selecting only English-written articles to avoid translation problems;
– *subject area*, selecting "Business, Management and Accounting".

In this way, 142 document results were selected based on their titles, abstracts and introductions and screened to determine which pieces of literature were pertinent to the investigated topic. Only 26 articles were included in the final dataset because the analysis classified the other 116 articles as irrelevant and they were discarded for the following reasons:

– 38 articles did not pertain to either BDA or accounting fields of research;
– 49 articles did not regard BDA (concerning only accounting without connections with BDA research);
– 29 articles did not pertain to accounting (concerning only BDA without connections with the accounting field of research).

Therefore, the analysis focused on 26 articles. An analysis of the temporal distribution of these studies showed that the academic debate on BDA in accounting has grown significantly in the last two years (Fig. 1). Indeed, to consider the temporal evolution of the topic and not exclude significant literature contributions, the search criteria for the implemented literature review did not include a timespan; however, most of the sampled articles are nonetheless very recent. This is consistent with the extant literature emphasising initial resistance and the actual delay in BDA adoption in accounting and auditing (Hamdam *et al.*, 2021). Although organisations are increasingly using BDA, the accounting and auditing professions were at first hesitant to benefit from this innovation, recognising the need for a paradigm shift in their tasks, responsibilities and operational methods (Vasarhelyi *et al.*, 2015). It is evident that BDA represents a shaping force, but it is yet unknown how and how much accounting and auditing practices will change.

Figure 1. – *Temporal distribution of the final dataset (n. of sampled studies per year)*

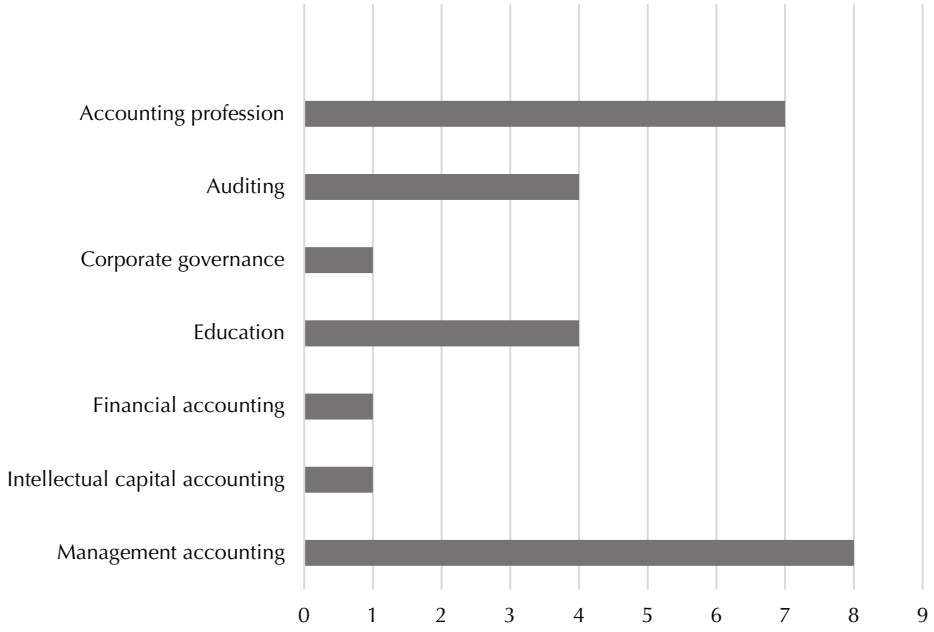


As described above, the subject area represents one of the search criteria initially set in Scopus as "Business, Management and Accounting". In particular, the analysis shows that most of the sampled studies (18 out of 26) were published in accounting and auditing journals, identifying 12 different scientific journals pertaining specifically to this field of research (Fig. 2).

Figure 2. – *Number of sampled studies published in accounting and auditing journals*

The sampled studies could be grouped according to the peculiar perspective of the research adopted in the accounting field. In this way, the chapter will examine the correlation between the issues discussed and the theories adopted in the sampled studies. Most of the examined articles concerned management accounting, auditing, education and the accounting profession (Fig. 3).

Figure 3. – *Distribution of the final dataset according to the accounting perspectives of the research (n. of sampled studies per accounting perspective)*



The perspective of research adopted by most of the sampled studies was **management accounting**. Its relevance is related to organisations' need to analyse a huge volume of structured and unstructured data (i.e., BD) through advanced analytic techniques (i.e., BDA) to rapidly gather insights and answers. This process, in turn, permits to make better decisions and take corrective actions quickly. This may generate a competitive advantage and improve business performance (Ciampi *et al.*, 2021; Ghasemaghaei and Calic, 2020; Mikalef *et al.*, 2019). Inside this rapid and proactive process, management accountants assume the tasks and responsibilities of both data analysts and business executives (Lawson, 2019). On the one hand, data analysts implement technical tasks, but they lack knowledge in some significant organisational areas and lack the ability to recognise the right questions to ask in certain rele-

vant situations (Wadan and Teuteberg, 2019). On the other hand, business executives do not completely grasp BDA's full potential. The relationship between managers and management accountants becomes closer and more effective because of BD. With the aid of new skill sets, management accountants relate these two organisational figures while also paying particular attention to organisational performance (Lawson, 2016). Therefore, management accounting in the BDA age requires maintaining a focus on performance and adopting new analytical and relational skills (Elkmash *et al.*, 2021). Indeed, BDA is now recognised as a primary source of competitive advantage, performance and innovation (Chaudhary *et al.*, 2015; Grover *et al.*, 2018; Mikalef *et al.*, 2019). Management accountants can use additional analytical methods to detect processes and product excellence combined with diminishing costs. Businesses of every size and industry are trying to implement BDA extensively in efforts to increase their performance (Munir *et al.*, 2022). As a result, many corporate functions and roles are changing, both in their requirements and in their scope of application. The management accounting profession is undergoing the most radical change, given the centrality of data for this function (Bhimani and Willcocks, 2014; Lawson, 2019). Their data-driven tasks serve as the main foundation for managerial decision-making and must now be remodelled through the application of cutting-edge technologies (Brands and Holtzblatt, 2015). Therefore, a paradigmatic shift in the skill set required of management accountants in organisations across all industries is necessary. Information technology and business analytics expertise are now seen as essential for this role (Bhimani and Willcocks, 2014; Payne, 2014). To be truly relational between the figures of the data scientist and the business executive, the management accountant's role must possess systematic, mathematical-statistical and business analytics skills. The new profile and the required skills create a clear break with the role traditionally ascribed to management accounting, which was based on repetitive tasks that would instead be automated thanks to BDA, highlighting the need to make and recognise new human skills and judgement as irreplaceable for organisations (Bhimani and Willcocks, 2014).

The second perspective of research mostly adopted in the examined sample of studies was **auditing**. The advent of BDA implies new opportunities and challenges for auditors. The opportunities are related to the availability of a number of continuously updated data and analytical tools (e.g., predictive models, machine learning techniques, artificial intelligence, statistical analysis, visualisation techniques, data warehouses, etc.; Brown-Liburd *et al.*, 2015) to support the auditing function. BDA implementation can potentially reduce the drawbacks arising from auditors' lack of experience, human cognitive lim-

itations and the impossibility of providing objective and unbiased audit judgement (Fawad, 2019). BDA in auditing may improve audit quality and support fraud detection. Therefore, BDA has the potential to complement the traditional items of audit activity by increasing the volume, reliability and relevance of the audit evidence (Yoon *et al.*, 2015). However, these innovative elements cannot replace the auditor's professional judgement. The auditor must handle the large volume of data, know how to use the required technological tools and, through this, grasp information and express professional judgement. Indeed, in their role, auditors must cope with data overload (Yoon *et al.*, 2015), take into account the possible ambiguity of informational insights that can be inferred from data from different sources (Brown-Liburd *et al.*, 2015) and rely on auditing standards that are not up-to-date or suitable for the BD era (Appelbaum, 2017a; Krahel and Titera, 2015). These factors constitute challenges in the auditing field, especially in relation to the choice and implementation of analytical risk assessment procedures (Alles, 2015; Alles and Gray, 2016; Cao *et al.*, 2015; Elkmash *et al.*, 2021; Krahel and Titera, 2015; Yoon *et al.*, 2015). BDA radically changes the way auditors obtain information and make decisions (Brown-Liburd *et al.*, 2015; Vasarhelyi *et al.*, 2015). Faced with this, the audit profession has developed an initial scepticism and does not seem to be responding quickly to the adoption of the required technology. This delay in adapting and adopting BDA to support their audit work threatens to change both the relevant role of auditors and the way auditors are viewed in society (Alles, 2015; Vasarhelyi *et al.*, 2015).

The third perspective of research mostly adopted in the examined sample of studies was **education**. The so-called "industrial data scientist" appears as a new professional figure of Industry 4.0, having precise BDA-related tasks such as data preparation, data analysis and data application (Lorenz *et al.*, 2015; Oesterreich and Teuteberg, 2019). These tasks require analytical and mathematical-statistical skills to collect and organise large unstructured datasets to identify correlations and draw conclusions. These skills, however, are no longer relegated only to a few specific professionals but are increasingly and extensively demanded, along with organisational knowledge and communication skills (Lorenz *et al.*, 2015; McAfee *et al.*, 2012). Inevitably, auditors' and accountants' skills will be associated with BDA; current accountants and auditors must develop an analytics mindset by being familiar with data and technologies.

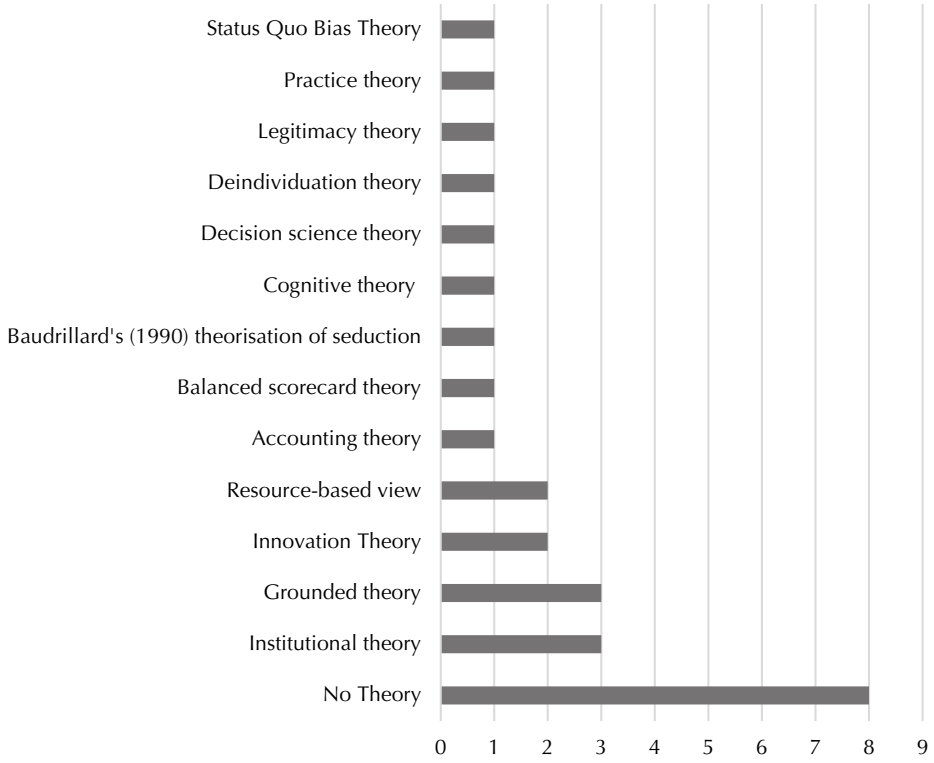
The fourth main perspective of analysis relates to the **accounting profession**, which, in the studies reviewed, was closely linked to the evolution required in accounting education (i.e., the previous research perspective). Indeed, the advent of BDA and recent technological developments are profound-

ly transforming the accounting profession, precisely changing the intrinsic nature of the roles and tasks assigned to accountants (Brands and Holtzblatt, 2015; Oesterreich and Teuteberg, 2019). BD and BDA have led to a cross-cutting economic revolution, transforming work practices and the resulting skills required even outside the technology sector (Berger and Frey, 2016). Thus, there is an increased demand for digital skills in all sectors, especially in accounting, where data has always played a central role. Therefore, candidates entering the accounting profession need to demonstrate remarkable expertise, both in the traditional areas of accounting and in data analysis (Drew, 2018). These new requirements encompass a wide range of skills expected in candidates, from basic Information and Communications Technology (ICT) skills for spreadsheet manipulation to more advanced ICT skills based on advanced analytics and programming (Berger and Frey, 2016). Therefore, business analytics and ICT skills are considered essential for entry into the accounting profession. Thus, there is a paradigm shift in the skill profile expected of accountants working in organisations across all sectors (Bhimani and Willcocks, 2014; Payne, 2014). In addition to business analytics and ICT skills that play a key role in the required profile, the new competencies related to the advent of BDA and recently required to accounting professionals are also based on the ability to interpret collected data, develop critical thinking and gather insights through technological tools. The role of the professional accountant is thus expected to approach without overlapping that of the data scientist acquiring mathematical-statistical skills and business analytics capabilities. To provide a precise reference in this regard, a recently revised competency framework (IMA, 2018) recognised six core competency areas that accountants should possess to fulfil their role: reporting, control, strategic management and leadership as common core competencies, to which are added technological and analytical skills. These are described as the skills needed to manage technology and analyse data with the aim of improving organisational performance, and they can also be declined differently according to the precise organisational role played by the accountant (IMA, 2018). It is evident that these competences are not yet described in great detail and do not lend themselves to unambiguous interpretations. The approaches to acquiring these skills are also manifold. Moreover, techniques, tools and terms used in data analysis and interpretation are constantly evolving and changing. Therefore, not only will the required skills and the profile of the accounting profession's aspirants often have to be integrated, but the accounting curricula themselves will also have to evolve continuously to remain relevant and in step with the digital evolution (Dow *et al.*, 2021). Indeed, the role of the accountant is changing considerably and seems to be shifting

from the function of accountant to the position of business partner (Baldvinsdottir *et al.*, 2009; Burns and Baldvinsdottir, 2005; Goretzki *et al.*, 2013; Samanthi and Gooneratne, 2022). This requires considerable effort and integration to be made to the accounting professional's profile, in the belief that the demand for such an integrated curriculum can help the evolution of the profession itself, recognising a new role for the professional who possesses strong data analysis skills to complement accounting expertise. To respond to these new demands and certify the integrated profile of candidates, the main institutions involved in the certification of the accounting profession worldwide are updating their certification examinations, adding questions aimed at certifying the skills developed by candidates with reference to BDA, in data analysis and interpretation (ACCA, 2020; CPA Evolution, 2020; American Institute of Certified Public Accountants, 2018). There is a growing belief that aspiring accountancy professionals with technical skills can facilitate their future organisations in capturing value and a competitive advantage from BDA. Therefore, technological advancement, digitisation and the data revolution have led to a strong need for the evolution of the role of accountants who have traditionally been stereotypically viewed as "number crunchers," "bean counters," "scorekeepers" and "financial gatekeepers" (Baldvinsdottir *et al.*, 2009; Bhimani and Willcocks, 2014; Graham *et al.*, 2012). The current BD revolution seems to show that changes in both institutions and business organisations are key drivers of changes in accountants (Goretzki *et al.*, 2013). The accountants of the future will focus only on tasks that are well differentiated from the automatic and repetitive tasks that can be efficiently performed by computers. Accountants will acquire a "colourful role" in and alongside organisations (Jeacle, 2008) thanks to their expertise, judgement and critical thinking skills (Dow *et al.*, 2021; Samanthi and Gooneratne, 2022). Accountants thus become business partners and advisors (Baldvinsdottir *et al.*, 2009) who, depending on the specific organisational context, may play different roles in decision-making, strategy formulation, systems development, organisational design and integrated reporting (Burns and Baldvinsdottir, 2005; Oesterreich and Teuteberg, 2019).

The sampled studies, organised according to these four perspectives of research, were thoroughly examined to identify the theoretical approaches adopted (Fig. 4).

Figure 4. – *Distribution of the final dataset according to the adopted theoretical approaches (n. of sampled studies per theoretical approach)*



Most of the sampled articles do not use a precise theoretical approach despite the Scopus research specifically looking for studies based on a theoretical foundation. After institutional theory, which is recalled and described in the next section, the three most recurrent theories in the sample are grounded theory, innovation theory and the resource-based view.

Grounded theory was employed in three sampled studies (Brivot *et al.*, 2017; Cong and Du, 2022; Senik *et al.*, 2013) classified in the research perspectives of management accounting and education, respectively. The fundamental assumption of this framework concerns the impossibility of finding an appropriate *a priori* paradigm (Brivot *et al.*, 2017). Therefore, grounded theory represents an interpretive and unusual approach based on generating theory from data to reflect reality and determine policy (Senik *et al.*, 2013). The adoption of grounded theory in BDA accounting studies is related to the acknowledgement that the BDA phenomenon is revolutionary in scope and

destructive of previous patterns and traditional paradigms. Grounded theory has been built on two key ideas: the need to move beyond the traditional frameworks that too frequently restrict the perception and view of reality in the social sciences (Krieger, 1984) and the opposition to the axiomatisation of social life (Williams *et al.*, 2006). Therefore, this framework leads to the inductive creation of a theoretical proposition based on observed data that can come from both experiential and archival sources. Studies based on grounded theory most often use qualitative methods of analysis that allow researchers to choose data sources according to their own judgment ("judgmental sampling"; Patton, 2002) to obtain a thorough understanding of the phenomenon under analysis. This implies a sort of theoretical sampling approach for collecting data, gathering insights, conducting theoretical comparisons and identifying the developing theory (Strauss and Corbin, 1998). The theoretical sampling approach could also make a number of attempts to gather further data. This process allows for the emergence of numerous key theoretical items that serve as the foundation for an explanation of the existence and nature of the expectation gaps found during the investigation (Senik *et al.*, 2013). In this way, it may offer plausible, imperfect but significant data-based conjectures in a situation that is highly unknown, marked by significant upheaval and radical change, and still up for initial discussion. Therefore, works based on grounded theory make an effort to find further and different frames to consider and analyse BDA issues. In addition to these further perspectives of analysis, the advantages of grounded theory include the ability to obtain additional information and knowledge about the justification and the advent of the phenomena, detailing the subject of study through the data acquired from a variety of sources instead of proceeding through conventional test hypotheses (Strauss and Corbin, 1998). This approach is particularly appropriate for BDA, which is a topic of study still in its infancy. BDA issues require further exploration and represent a relevant area for research because BD advent has lately been acknowledged as revolutionary across industries, organisations and fields of research. BDA suggests revaluating the nature and categorization of reality, the research methodologies employed in the analysis, the potential patterns of information and the process of knowledge building. This represents a significant epistemological revolution for which accounting is changing and most likely will continue to change (boyd and Crawford, 2012; Leitner-Hanetseder *et al.*, 2021; Napier, 2006). Grounded theory is strictly connected to this epistemological revolution, which examines data's ability to underpin and frame theory according to new perspectives (Cong and Du, 2022; La Torre *et al.*, 2018; McAbee *et al.*, 2017). Focusing on the accounting education perspective, grounded theory is also related to the knowledge-driven economy's **in-**

human capital theory (Senik *et al.*, 2013; Zula and Chermack, 2007). It is based on data and evidence concerning the impact of increased educational opportunities on the economic growth of a country, which can really boost the number of graduates each year. The theory is supported by data showing that more businesses found that not enough graduates were prepared for employment, specifically when considering prospective employers of graduates as the most important consumers (Senik *et al.*, 2013). This implies a need to focus on whether there is a knowledge or skill gap between what graduates of university programmes learn and what potential employers demand and prefer (Chang and Hwang, 2003; Francis and Minchington, 1999; McCartney *et al.*, 2002; Zaid and Martin, 2001). In this stream of research, **substantive theory** also plays a significant role (Senik and Broad, 2011). It suggests that educators' perceptions about matters primarily involving themselves, institutional values, commitments for skills development, supervision, training, innovation and students are what mainly influence and promote the growth of BDA skills in teaching. More specifically, concerns related to academic educators (e.g., their interests, expertise, age and skills), environmental aspects (e.g., importance of research-related duties, traditional university model, deadlines for completing academic-focused coursework, and poor student motivation) and involvement in IT-related initiatives represent the most critical items supposed to have a negative impact on the development of BDA capabilities (Senik and Broad, 2011). Employers and academia have been encouraged to work closely together to fill the gaps in the development of theoretical and operational skills (Chang and Hwang, 2003; Theuri and Gunn, 1998).

Like grounded theory, **innovation theory** is employed in two sampled studies (Dow *et al.*, 2021; Elkmash *et al.*, 2021) classified in the research perspectives of education and management accounting, respectively. This theoretical framework defines diffusion as the process by which an innovation spreads over time through a channel in a social system. It explores why, how and how quickly new ideas and technology spread (Rogers, 2010). Five steps are posited for the decision-making process: information gathering and awareness, persuasion, decision, implementation, confirmation and continuation or rejection. This process faces four primary potential roadblocks: the innovation itself, its communication channels, the social structure and the adoption time for the innovation (Chau, 1996; Rogers, 2010). These obstacles are also evident when applying this theory to the advent of BDA. Indeed, diffusion of innovation theory neglects several critical factors that can prevent some businesses from adopting BDA innovation, such as corporate difficulty in undertaking the process of BDA introduction or corporate scepticism concerning BDA relevance. For this reason, this theory by itself may be insufficient for arguing for BDA

acceptance. It may be supported and clarified by other theories, such as the **technological acceptance model** (Davis, 1989). As written above, the diffusion of innovation theory has also been applied in sampled accounting studies that adopt an educational approach, especially concerning incorporating the theory's five steps to BDA infusion in the accounting curriculum. Such application suggests that managing the process envisioned by the theory across knowledge, persuasion, decision, implementation and confirmation is key to developing an integrated curriculum (Dow *et al.*, 2021).

Resource-based view (RBV) is also employed in two sampled studies (Munir *et al.*, 2022; Oesterreich and Teuteberg, 2019) classified in the research perspectives of accountants (profession) and education, respectively. It is widely acknowledged as one of the key theories outlining how organisations can obtain and maintain a competitive advantage as a result of the resources they own and control (Barney, 2001; Munir *et al.*, 2022; Raphael and Schoemaker, 1993; Wernerfelt, 1984). Based on a firm's characteristics, resources and capabilities, the RBV focuses on the relationship between available resources and businesses' performance (Wamba *et al.*, 2017). The RBV is a significant and frequently applied theory for addressing BDA. According to the RBV, businesses are made up of a variety of resources or assets, including those connected to BD and BDA, that must cooperate to provide competence for a certain task (Penrose, 1959). Organisations that develop this peculiar approach will gain a valuable and irreplaceable aptitude for implementing worthy BDA to generate a competitive advantage (Vidgen *et al.*, 2017). Indeed, they can exploit hidden information and data patterns to maximise business value by referring to the vast amount of data they have acquired. However, BDA alone may not be enough to enhance performance and effectiveness. Additional intermediary factors may mitigate BD effects on company performance (Ghasemaghaei and Calic, 2019). Other resources, besides BD and BDA, are essential to the success of the same BD-related projects (Gupta and George, 2016; Vidgen *et al.*, 2017). For this reason, the concept of BDA capabilities has been proposed, focusing on the connection between its investment and the improvement in firm performance (Ghasemaghaei, 2020; Wamba *et al.*, 2017). The ability of an organisation to provide insight into the implementation of data management, technology and human skills to boost the business's competitiveness is reflected in its BDA capabilities (Akter *et al.*, 2016). For this reason, the limited availability of business resources might constitute a barrier to the successful adoption of BDA. Company size can result in such limited availability of resources (Oesterreich and Teuteberg, 2019). In comparison to larger firms, small and medium-sized enterprises (SMEs) may be less prone to making significant investments in data systems and BDA due to

limited financial, organisational and expertise resources (Caldeira and Ward, 2003). Employees of major corporations are likelier to possess BDA expertise than employees of SMEs. However, employees working in smaller businesses may not be required to possess BDA skills, demonstrating that the theory of resource constraints may be more appropriate in precisely these settings. In this way, the degree of BDA adoption, together with BDA expertise and IT abilities, should characterise an accountant's work profile (Oesterreich and Teuteberg, 2019). In addition to company size, the RBV can be used to hypothesize that the time delay for dissemination will be decreased by extremely rapid technical improvements. The amount of accumulated knowledge and ongoing investment in outdated technology are two critical issues in the diffusion of BDA. Indeed, the more massive the quantity of embedded knowledge, the less inclined organisations would be to replace existing technology with new tools. The persistent investment in outdated technology is startling. Organisations continue to invest resources in training employees and enhancing their consolidated (obsolete) abilities (Reinking *et al.*, 2015). For this reason, the RBV is strictly connected to **knowledge-based view theory** (Côrte-Real *et al.*, 2017). This theory asserts that a firm's knowledge resources are distinctive and incomparable. They should be combined and used to achieve positive outcomes and generate dynamic capabilities, such as organisational agility (Grant, 1996; Wu, 2006). High levels of employee involvement and expertise allow organisations to more effectively recognise the need for modifying current resources and to assess the necessary steps to accomplish these transformations. The performance benefits of knowledge management and BDA investments can be conceptualized using the knowledge-based view theory (Côrte-Real *et al.*, 2017; Pavlou *et al.*, 2005). Another peculiar theoretical framework adopted in the examined sample of accounting studies and related to the knowledge-based view theory is the **decision science theory** (La Torre *et al.*, 2019). BDA's primary use and corporate value, as discussed in the last chapter, are related to its capability to produce knowledge and enhance decision-making processes (Wang *et al.*, 2016).

Except for the institutional theory (examined in the following section), the three most recurrent theories (i.e., grounded theory, innovation theory and RBV) in the sampled articles were explored regarding their application and investigation of BDA. The other theories employed in the sampled studies are numerous – there is a different theory for each sampled study in most cases. Thus, there is a high degree of fragmentation that emphasises a lack of recognition of one or a few theoretical approaches considered fundamental to the topic examined here. Moreover, most of the adopted theoretical frameworks differ from the traditional ones employed in the accounting field of research.

For this reason, the focus going forward is on the research perspectives identified in the sample analysis – for each of these research perspectives, the peculiar theories adopted are explored.

In the examined sample, as described above, the most adopted research perspective was management accounting. Indeed, there is a significant relationship between BDA and management accounting (Appelbaum *et al.*, 2017b). The advent and exploitation of BDA by organisations has an impact on the managerial accounting profession because management accountants largely use data gleaned from accounting records to support business managers. The role of management accounting has also evolved from historical value reporting to increasingly real-time and forward-looking data to support company competitiveness, which has significantly increased with advances in technology (Cokins, 2013). It is critical for management accountants to adjust their role to support businesses in gaining a competitive edge based on their ability to interpret and analyse various types of data (Nielsen, 2014). Businesses today require more timely and valuable information. Management accountants should not only produce descriptive reports to address inquiries about past events but also forecasts that take uncertainty and risk into consideration to provide decision-related information (Nielsen, 2015). Moreover, management accounting has broadened its conventional scope to consider factors that influence business performance both inside and outside of the company. The sampled studies adopting management accounting as the research perspective are based on five different theoretical frameworks (Table 1). Three of these theories are also the most used in the total sample, but two theoretical frameworks (i.e., balanced scorecard theory and Baudrillard's theorisation of seduction) are adopted only in this stream of analysis.

Table 1. – *Adopted theoretical approaches in the studies categorised under the perspective of "management accounting"*

Accounting perspective	**Adopted theory**	**N° of sampled studies**
Management accounting	No Theory	2
	Institutional theory	2
	Innovation Theory	1
	Grounded theory	1
	Baudrillard's theorisation of seduction	1
	Balanced scorecard theory	1

The first framework adopted only in the sampled articles referring to management accounting is **balanced scorecard theory**. It introduces a view concerning the advent and integration of BDA into the enterprise system for monitoring business results according to management accounting (Appelbaum *et al.*, 2017b). It identifies four points of view that deeply influence business performance (Kaplan and Norton, 2001): financial, customer, internal business processes, learning and growth. To explore these factors and understand their impact, each organisation should ask itself four different questions:

– How do we appear to our shareholders?
– How do our clients perceive us?
– What must we be experts at?
– Can we keep advancing and adding value?

The first financial perspective (or question) regards the development, performance and risk management plan as seen from the viewpoint of the shareholders. The strategy for adding value and differentiating oneself from the competition is considered from the second perspective, according to the customer viewpoint. The strategic targets of various business activities that can result in customers' and shareholders' convenience are included in the third perspective concerning internal business processes. Finally, fostering an environment that encourages organisational change, innovation and growth falls under the learning and growth perspective. Balanced scorecard implementation and long-term financial performance are positively correlated (Davis and Albright, 2004). To measure corporate performance, BDA can be integrated into enterprise systems using the balanced scorecard approach. The measurement of business performance and the provision of other helpful information are two ways in which management accountants might profit from BDA. To implement BDA in organisational primary processes, a balanced scorecard may be adopted under the management accounting key areas concerning performance measurement, planning and decision-making. Different types of BDA can be used to offer a thorough measurement of each aspect (financial, customer, internal process, learning and growth). These four perspectives can be used to measure company performance using descriptive, predictive and prescriptive analytics. When a corporation develops a strategic management system based on the balanced scorecard theory, BDA also constitutes a significant part of the feedback and learning process. Indeed, the learning and growth viewpoint assesses an organisation's capacity for innovation, improvement and learning, which is directly related to the value of the organisation. It evaluates a business's capacity to introduce new products, increase consumer value and sustainably boost operational effectiveness. The market

share of new products and employee training costs represent two examples of measures concerning the learning and growth perspective. With the use of these metrics, an organisation's key internal business processes match human resources and information technology with strategic requirements (Kaplan and Norton, 2001).

The second framework adopted only in the sampled articles referring to management accounting was **Baudrillard's theorisation of seduction**. It is particularly peculiar (Baudrillard, 1993). Being a reversible and mortal process, seduction is more powerful than both power and production because power aspires to be irreversible, cumulative and immortal like value (Baudrillard, 2007). In Baudrillard's theory of seduction, the attribute of reversibility is linked to the idea of a gift. Since giving a gift makes the recipient a debtor, true power does not come from enforcing discipline (for example, when a king metes out punishment on a slave; conversely, the slave whose life is preserved will always be a debtor to the ruler). This theory challenges Foucault's idea of disciplinary power (Foucault, 1995), contending that economic power cannot endure if all appropriation and taking are carried out unilaterally (in the example proposed, it would be like asking how the ruler can exercise his power where he has taken the life of the slave). In contrast to Foucault's idea of disciplinary authority, Baudrillard argues that seduction offers an alternative organisational strategy by taking into account features of reversibility and choice. Based on this theorisation, instead of concentrating on the exchange of commodities, organisations should adequately examine symbolic exchange that might develop into a peculiar channel for the manifestation of control. In fact, seduction and symbolic exchange are empathetic processes; people are initiated into a collectivity and feel great satisfaction as they embody a new and radical otherness. In this way, Baudrillard's theory of seduction can be applied to the current BDA phenomenon. Living as a radical outsider or being inducted into a group need not take place in person in today's highly technological environment. A person can now join a huge community thanks to social media. Technology and software that create avatars, interactive game worlds, and online communities enable and empower the development and diffusion of feelings, including enthusiasm, happiness, regret and anxiety (Chapman *et al.*, 2021). In this view, the potential for control becomes evident in terms of both the elicitation of effort and the direction of commodity exchange. It can be founded upon play and fun in a carefully orchestrated set of relationships between a platform organisation, its users and its partners. Control can be exercised through gratifying gamification and social media, as well as through entertaining symbolic transactions that are distinct from commodity exchange but clearly tied to it (Chapman *et al.*, 2021).

In the examined sample, after management accounting, the second most adopted research perspective was auditing. As illustrated above, there is a growing and clearly emerging stream of research on auditing and BDA (Appelbaum *et al.*, 2017a; Appelbaum *et al.*, 2018; Borthick and Pennington, 2017; Gepp *et al.*, 2018; Krahel and Titera, 2015; La Torre *et al.*, 2019). The sampled studies adopting auditing as a research perspective are based on two different theoretical frameworks: cognitive theory and practice theory.

According to **cognitive theory**, judgment is influenced by internal processes, presumably moulded and governed by social influence, as well as by the surrounding environments and personal characteristics (Trotman *et al.*, 2011). Most studies on judgment and decision-making adopt this theory to assess the quality of judgment, outline the process by which judgments are generated, identify factors that influence these judgments, test critical aspects of the cognitive processes involved in making judgments and enhance the judgment process (Trotman *et al.*, 2015). For this reason, cognitive theory may also be adopted to evaluate an auditor's ability to gather informational insights and carry out activities, including information encoding, retrieval and analysis tasks (Libby and Luft, 1993; Trotman, 1995). Auditors' cognitive processes (e.g., recognition and response to information signals) may be affected by cognitive deficits and emotional issues when they are subjected to large and various amounts of data in a short time span (Brown-Liburd *et al.*, 2015; Fawad, 2019). BD has been very attractive since its advent because of its potential effects on the auditing profession, but its complete and effective incorporation into audits has yet to occur (Hamdam *et al.*, 2021). Specifically, the auditors' cognitive process represents one potential problem that might influence audit judgment and decision-making in the BD context. The most effective way to introduce BD into auditors' cognitive processes, resulting in high-quality, accurate and reliable information, is still uncertain and understudied (Brown-Liburd *et al.*, 2015; Fawad, 2019). Additionally, it is crucial to examine how auditors apply BDA to reach their results and decisions. Auditors use either intuitive or deliberative data processing approaches for combining and interpreting BD. Consequently, auditors may have difficulty recognising significant red flag trends, inconsistencies and anomalies in data (Wolfe *et al.*, 2016). Knowing which cognitive patterns have an impact on audit judgment and decision-making is crucial. Therefore, in the case of BDA, the social cognitive theory can call for and support both examining and understanding how the data and evidence available through the audit procedures deliberately or accidentally alter human processes such as understanding, organising and controlling evaluated options and final decisions (Hamdam *et al.*, 2021).

The other peculiar framework characterising auditing sampled studies is **practice theory** (Schatzki, 2005), which encourages shifting the focus from action-centred theories to a thorough practice-oriented approach (Caldwell, 2012). A practice develops as a result of human activities, but it does not consist of any combination of actions (La Torre *et al.*, 2019). As such, it may be oversimplified and limiting to identify a practice as just a collection of acts without taking into account the motivations and ways in which those actions are carried out (Schatzki, 2006). Practice theory sheds light on the importance of motivations and the ways actions take place, are coordinated and are conducted in a particular practice. This may support the analysis of the evolution of auditing activities and practices within the BDA ecosystem (La Torre *et al.*, 2019). Specifically, BD advent and BDA implementation present auditors with both opportunities and issues. By modifying audit judgments, reducing the amount of time required to complete the audit process and improving the degree of reliability of the evidence generated, BDA is altering the way auditing activities can be carried out. On the one hand, BD's huge volume, data (ir)relevance, information processing and complexity may be barriers to applying BD in auditing (Brown-Liburd *et al.*, 2015; Yoon *et al.*, 2015). On the other hand, there is growing recognition that gathering and analysing huge volumes of data from a variety of sources can improve audit results and judgements (Appelbaum *et al.*, 2017a). However, auditors must follow ethical guidelines that may go above and beyond their legal obligations when they access and use certain personal data. As described in the previous chapter, privacy is becoming increasingly important, mainly due to the increased number of ways (licit and illicit) to retrieve desired data (Anderson, 2006). For this reason, the organisational approach by which data are collected and handled brings with it substantial issues related to privacy (Cao *et al.*, 2015). To implement effective data protection processes, businesses need to embrace structural changes in their corporate policies, operations and governance. Therefore, the accountability of all governance players, including external auditors, has changed as a result of further issues and challenges to data security. Since deriving value from BD depends on all the subjects involved in the governance process being aware of the dangers associated with collecting BD, the demand for data security is also changing auditing. Organisations are both strong and vulnerable at the same time as a result of BD and limited data protection. Specifically, since BD "voracity" (La Torre *et al.*, 2018) leads to a continual search for data outside of legal and ethical bounds, data security and privacy issues represent some of the major hurdles and organisational challenges to exploiting BD (Akoka *et al.*, 2017; Alharthi *et al.*, 2017). Practice theory aims to provide support in evaluating auditing

changes related to the (needed) development and evolution of data protection practices (La Torre *et al.*, 2019).

In the examined sample, after management accounting and auditing, the other most adopted research perspectives were education and the accounting profession. The four sampled articles categorised in the education research perspective were based on innovation theory (Dow *et al.*, 2021), RBV (Oesterreich and Teuteberg, 2019) and grounded theory (Senik *et al.*, 2013), which have already been examined above. The last one was not based on a theoretical framework. The three sampled articles categorised in the accountants' research perspective are based on the RBV (Munir *et al.*, 2022), institutional theory (Samanthi and Gooneratne, 2022) and **status quo bias theory** (Schmidt *et al.*, 2020b). This is intended to explain the willingness to retain the existing status through the assessment of cost, benefit, potential value, peer opinion, self-efficacy and organisational commitment for transformation (Kim and Kankanhalli, 2009; Samuelson and Zeckhauser, 1988). These factors might explain the difficulty in accepting BDA and the consequent moderate adoption of new technology in accounting and auditing environments. It seems to be closely related to institutional theory, which outlines how certain procedures developed inside a company or industry become rigorous norms that need to be followed for legitimacy (DiMaggio and Powell, 1983). The combination of the two frameworks (i.e., status quo bias theory and institutional theory) may clarify the accounting profession's current commitment to the status quo and how embedded technologies are institutionalised within the industry (Schmidt *et al.*, 2020b). It can then be employed to investigate how technological advances, paradigms and attitudes can substitute these established practices to develop a more profitable and effective industry (Agyekum and Singh, 2018).

The following section will consider the theoretical frameworks that are more traditionally adopted in accounting and auditing literature – such as institutional theory (Fahlevi *et al.*, 2021; Samanthi and Gooneratne, 2022; Vitale *et al.*, 2020) and legitimacy theory (Fotaki *et al.*, 2020) – that could be applied to BDA studies and that are deepened in a few sampled studies that are (partly) dedicated to discussing accounting theoretical frameworks for BDA (Cong and Du, 2022; Ibrahim *et al.*, 2021; Leitner-Hanetseder and Lehner, 2022; Vollmer, 2019).

2.4. Established theoretical frameworks applied to BDA development in accounting studies

The oldest sampled article (Tomkins, 1999) is not specifically about BDA, but it specifies that data needs structure and order to be useful and to provide

guidance in addressing accounting problems. This is strictly related to the need for a hierarchical and generalised theory of accounting. Legitimacy theory, stakeholder theory, institutional theory, agency theory and signalling theory will be examined here to understand how they could enable researchers to perceive and interpret the key factors of BDA development in accounting.

One of the most extensively studied accounting theories is **legitimacy theory** (Suchman, 1995; Suddaby *et al.*, 2017). It makes the assumption that businesses follow a "social contract" centred on gaining and maintaining social acceptance. To achieve social approval, businesses should minimise information asymmetry, be transparent and guarantee maximum disclosure (Ibrahim *et al.*, 2021). This relates to the generalised view that an entity's acts are beneficial, suitable or adequate within a socially constituted set of rules, principles and concepts (Suchman, 1995). Legitimacy may be both moral and pragmatic (Fotaki *et al.*, 2020). Moral legitimacy is based on the normative (positive or negative) assessment of a firm's activity to determine whether the firm is acting properly and, thus, whether it is worthwhile to support it. Pragmatic legitimacy relates to the peculiar interests of a firm's multiple stakeholders, who determine whether it is in their own interests to support the firm under consideration. Companies in the current data-based economy are likely to face greater pragmatic and moral legitimacy difficulties in relation to the BDA threats and opportunities (Dumay, 2009; McFarland *et al.*, 2015). Many companies recognise that they often rely too heavily on management briefings to grasp the benefits and dangers related to BDA and emerging technologies, expressing concern about their expertise and capabilities in managing the disruption brought on by these technologies (Ernst and Young, 2020). Furthermore, as noted above, many parties are concerned about the ethical implications of BDA implementation (Fotaki *et al.*, 2020). Specifically, the high-technology industry has a particularly high frequency of ethical failings, with most of these cases involving data protection violations and illegal privacy acts (Institute of Business Ethics, 2020). As a result, corporations attempt to mitigate legitimacy difficulties posed by BDA issues to reduce stakeholders' concerns and boost market valuations (Bednar, 2012; Fombrun and Shanley, 1990; Musteen *et al.*, 2010; Thornton and Ocasio, 1999; Zajac and Westphal, 2004). From the perspective of stakeholders' satisfaction, the consistency between corporate disclosures and ethical practices is crucial for establishing both pragmatic and moral legitimacy (Berrone *et al.*, 2007; Logsdon and Yuthas, 1997; Strong *et al.*, 2001). Additionally, by generally acting ethically, businesses may even develop moral capital with stakeholders (Gardberg and Fombrun, 2006; Godfrey *et al.*, 2009; Zyglidopoulos *et al.*, 2016). The alignment between corporate statements and ethical practices through the imple-

mentation of proactive acts in BDA implementation may allow businesses to develop a reservoir of goodwill among their stakeholders that can serve as a coverage mechanism for eventual legitimacy crises (Dubey *et al.*, 2019; Kang *et al.*, 2016).

The legitimacy theory and the **stakeholder theory** are strongly intertwined. The relationship between an organisation and its (internal and external) stakeholders is addressed by stakeholder theory (Donaldson and Preston, 1995; Ibrahim *et al.*, 2021; Van der Laan *et al.*, 2008). It is articulated across three items that should be taken into account. First, the descriptive element focuses on corporate reporting practices while taking into account the combination of the divergent interests of the company and its stakeholders. Second, the instrumental element evaluates the attainment of organisational objectives and their disclosure through reporting. Third, the normative element aims to evaluate compliance with principles and norms based on moral standards, considering that stakeholders are expected to exert influence over the organisation and manifest expectations that are highly valuable to the business. This theoretical framework also introduces suggestions and recommendations, leading stakeholder theory and the **normative theory** of accounting closer together (Ibrahim *et al.*, 2021). This illustrates the necessity of eliminating the information asymmetry that exists between internal stakeholders (mostly managers) and external stakeholders. **Signalling theory** presupposes that this "information bridge" must be constructed and preserved between stakeholders (Morris, 1987). This may be exceedingly challenging for companies utilising and implementing BDA, as many of their operations cannot be directly witnessed by the majority of interested parties (Fotaki *et al.*, 2020). Firms may attempt to minimise this information asymmetry by signalling their publicly accessible ethical practices (Connelly *et al.*, 2011). The pragmatic and moral legitimacy concerns of prospective stakeholders will be reduced if the signalled BDA practices (those shared with stakeholders) are actually trustworthy (Lewis, 2003; Schlegelmilch and Pollach, 2005). The signalled BDA practices represent a mechanism improving transparency and reducing information asymmetry. More generally, according to the **agency theory** (Jenson and Meckling, 1976), BDA may be conceived as monitoring tools able to increase disclosure quality, mitigate agency costs and prevent potential conflicts (Ibrahim *et al.*, 2021; Vera-Baquero *et al.*, 2015). Moreover, the consideration of the institutionalisation of social structures, according to institutional theory, may enhance the assessment of the connection between the entity and its stakeholders.

According to **institutional theory**, organisations are affected by their institutional environments, which are made up of socially produced myths, rules

and explanations. These factors limit how an organisation operates and interacts (DiMaggio and Powell, 1983; Meyer and Rowan, 1977). Accounting procedures and their modifications are thought to be a construct and reaction to organisational contextual change, in accordance with institutional theory (Damayanthi and Gooneratne, 2017; Fahlevi *et al.*, 2021). Over time, as an organisation adapts to internal and external changes, its current rules and procedures will change. The new rules may (or may not) be institutionalised as new organisational procedures. Additionally, different motivations for change could produce different outcomes and have an impact on the organisation. This involves the need to adhere to a set of institutionalised beliefs – that is, to become isomorphic (Leotta and Ruggeri, 2012). Institutional isomorphism results in homogeneous organisational practices and can be coercive, normative and mimicking (Samanthi and Gooneratne, 2022). Institutional theory has evolved and expanded to cover several directions over time (Willmott, 2015). This has paved the way for a variety of institutional methods, such as old institutional economics (Scapens and Burns, 2000), new institutional economics (Foster and Ward, 1994) and new institutional sociology (Covaleski *et al.*, 1996). Specifically, drawing on old institutional economics, this theoretical framework demonstrates the significance of organisational routines and institutions in determining the mechanisms of accounting transformation (Scapens and Burns, 2000). Accounting is considered a typical organisational practice that may become institutionalised over time (Samanthi and Gooneratne, 2022). This theoretical framework focuses on how routines and norms evolve over time, how visible they are in reality (Quinn, 2011; Van der Steen, 2011) and the conflicts that might arise between institutions inside an organisation and more general institutions that may be involved in processes of accounting transformation (Burns and Baldvinsdottir, 2005; Yazdifar *et al.*, 2008). This framework has been criticised for failing to account for external institutions driving change, changes' long-term implications, individual initiative and confidence in the process of transformation (Siti-Nabiha and Scapens, 2005; Yazdifar *et al.*, 2008). A possible extension of this framework aims to solve the critical issues (Ter Bogt and Scapens, 2019), taking into account both broader and local institutions, the tensions that come from them and how these tensions affect norms, practices and actions across time while reflecting the mediating function of the so-called "**situated rationality**". It refers to a systematic interaction between institutions that combine authority, trust and norms, as well as the processes through which agents' considerations of norms and procedures are influenced by assertions, which are assumed to be true and serve as a foundation for their deliberate acts. This theory holds that relationships and context are the main determinants of rationality. Over time, institu-

tions might change into routines and rules (Ter Bogt and Scapens, 2019). Rules are the formal statements of processes, and routines are how those rules are put into effect. Together, these two factors eventually affect the course of action that an individual takes. In accordance with these issues, accounting practices constitute a set of rules and routines (Busco and Scapens, 2011). Rules are, for instance, accounting manuals; they are expressed in documentation on formal accounting procedures, representing the formally accepted way of proceeding. Routines are instead behaviours governed by rules that, with enough repetition, could become systematic and rely on tacit knowledge. Routines are, hence, the actual methods by which things are carried out. Management accounting and control systems are crucial in this theoretical framework for defining corporate cultural assumptions (Busco, 2008). Moreover, the institutionalisation of management accounting transformation, institutional tensions in role change and the impacts of institutions on the evolving role of the accountant might all be explored by adopting this theoretical framework (Burns and Baldvinsdottir, 2005; Goretzki *et al.*, 2013; Guerreiro *et al.*, 2006; Tahat *et al.*, 2018; Youssef, 2013). It contributes by initially recognising the plurality of institutions and varieties of rationality, shedding light on how local and broader institutions influence the changing function of accountants and how prevailing situated rationalities affect accountants' responses to such transformations. Institutions may force change, but how people react depends on how much confidence they have in the results of a given action. According to this theoretical perspective, accounting and control systems are an organised set of routines that can both impact and be affected by institutions (Busco, 2008; Vitale *et al.*, 2020). Changes in management accounting might happen gradually through routines being replicated and institutionalised or they can be fairly revolutionary and brought on by significant external changes. In the latter scenario, the exogenous event may enforce rapid and significant modifications to institutions' routines (Busco and Scapens, 2011). According to a revised interpretation of this theoretical framework, there are not always rules – that is, formal procedures that specify how things should be done (Quinn, 2011, 2014). This is especially true in informal, less organised settings, such as SMEs. In these cases, routines can substitute formal norms and can be of two types: ostensive and performative (Pentland and Feldman, 2005). Performative routines are precise procedures that are followed in accordance with underlying rules (if applicable) or expectations (Bertz and Quinn, 2014). Ostensive routines are the standards of conduct or the guide that organisations use when carrying out performative routines (Quinn, 2014). The latter may be a norm that is unquestionably accepted, with an eventual significant tacit component (Bertz and Quinn, 2021). Ostensive routines can be used instead of

formal norms in unstructured environments, whereas performative routines are related to traditional ones (Busco and Scapens, 2011; Quinn, 2014). In the end, the interplay between the two routine dimensions can affect artefacts or result in the physical manifestation of routines (Pentland and Feldman, 2005). Ostensive and performative routines are reciprocally constitutive and recursive. Performative routines are diversified because they include repeating activities that cannot be precisely repeated. There are times when ostensive routines are relatively constant, and when this is the case, performative routines tend to shift to better complement them. Stable control systems or changing ones derive from the effectiveness and replication of performative routines against a backdrop of ostensive routines. Changes in management control systems may result from exogenous events that unfreeze the system or evolutionary dynamics shocks (Busco, 2008; Vitale *et al.*, 2020). In this sense, an external shock such as the advent of BD could cause a drastic change in organisational routines; however, if the innovation is resisted, this transformation may not take place (in a situation of substantial stability), or it may be realised gradually and only after the initial opposition has been overcome. BD by itself is insufficient to affect change; instead, several micro-level methods are needed. For instance, a learning-by-doing approach (derived from the repetition of routines) and managerial culture may be essential in facilitating management control system change (or stability). Additionally, a shock from the outside does not always mean that corporate procedures will be drastically altered. Even if the development of BD had major implications for a few primarily non-financial control mechanisms, it had a minimal impact on accounting models (Vitale *et al.*, 2020).

2.5. Concluding remarks

The BD revolution and the growing attention to BDA have also influenced accounting research, which can be developed on new and uncommon datasets to generate more evidence and take empirical archival studies to a higher level (Griffin and Wright, 2015; Vasarhelyi *et al.*, 2015). It has emerged that the relevance of BD and BDA lacks a univocal (or at least convergent) theoretical basis (Mikalef *et al.*, 2019). Indeed, BDA involves reconsidering the nature and categorisation of reality, the research methodologies, the potential connections and the process of knowledge building. This represents a significant epistemological revolution for which accounting is changing and most likely will continue to change (boyd and Crawford, 2012; Leitner-Hanetseder *et al.*, 2021; Napier, 2006). Because most BDA research adopts a data-driven meth-

odology, which is completely at odds with the scientific epistemological viewpoints that have long been embraced in accounting, the BD epistemological revolution needs to be studied further (La Torre *et al.*, 2018; McAbee *et al.*, 2017). The epistemological revolution has suggested the ability of data to undergird and frame theory (Cong and Du, 2022). This is not new – at least in domains other than accounting. Since the late 1970s, researchers in statistics have suggested using exploratory analytics to characterise and visualise data where a hypothesis could not be established (Tukey, 1977). Today, many studies suggest that data can generate theory in a paradigm called grounded theory (Glaser and Strauss, 1967). This has been applied in many articles sampled and examined in this chapter. The purpose of this theory is to identify and discuss the main issues that emerge "from the field" through the collection and analysis of data. Guided by grounded theory, a number of studies aim to show as new research approaches and new frameworks can be both grounded in data (Walsh *et al.*, 2015). The analysis implemented in this chapter highlights that the sampled studies based on grounded theories focus on BDA. They put data at the centre, starting with the analysis of the data and finally coming to describe it. The interpretative approach aims to collect data to ascertain numerous key theoretical items that serve as the foundation of the existence and nature of the BDA revolutionary phenomenon (Senik at al., 2013). Conversely, all the other examined theoretical frameworks put man and organisation (knowledge, skill to control available resources, and exercise of power) at the centre. This consideration has two major implications. First, it attempts to find a common point in the high degree of theoretical fragmentation that characterises the analysed sample of studies. Indeed, most of the sampled studies either lacked a theoretical approach or adopted a peculiar framework. Second, acknowledging the centrality of data because of the BD-BDA revolution, a need emerges to make and recognise as irreplaceable human skills and judgement to fully grasp BDA value. Already the academic contributions that had traditionally defined and analysed accounting information systems (Amaduzzi, 1972; Marchi, 2003), focusing on the impact of the IT revolution on corporate systems and accounting, highlighted that data, information and knowledge are all key issues for businesses (Culasso, 2004), but they represent three different and consecutive levels (Varaldo, 1990). Collecting data does not automatically mean generating information, and even once information has been elaborated, it does not automatically turn into knowledge, as will also be highlighted in the fifth chapter.

3.
Data regulations in the European Union

3.1. Introduction

Companies are increasingly using big data analytics to enhance their internal decision-making, tailor their product offerings to customer needs and reap economic benefits (Lehner *et al.*, 2022). While data collection and processing have been recognised as an important source of business model innovation, competitive effectiveness and operational efficiency, there is an increasing awareness that the power which stems from data ownership is asymmetrically skewed in favour of the large technology companies that have almost "exclusive" data access and advanced storage and processing capabilities (Andrew and Baker, 2021; West, 2019; Zuboff, 2015). Furthermore, both academics and practitioners raised concerns about the role of big data analytics in increasing user privacy and security threats (La Torre *et al.*, 2018), limiting user autonomy and freedom (Andrew and Baker, 2021), exploitation of labour employed at all the stages of the value chain in data business (Fuchs, 2010), lack of algorithmic accountability (Martin, 2019), and pervasive worker control (Chai and Scully, 2019).

Regulatory efforts to make companies more accountable for the use of data and algorithmic systems include a combination of top-down regulation, self- and co-regulation as well as development of "soft" voluntary standards and principles (Finck, 2018; Yoo and Lai, 2020). While *self-regulation* occurs when the big data companies independently self-organize together in order to establish ethical guidelines of the industry (e.g., Partnership on AI), *co-regulation* (e.g., High Level Expert Group on AI (HLEG AI) or DOT Europe) represents a hybrid solution when public authorities and private companies collaborate to regulate private companies' activity and consult policy makers (Finck, 2018; Wieringa, 2020). While both self- and co-regulation are lauded for their ability to reach public policy objectives without compromising the

activity of private entities, such arrangements have been accused of "ethics washing" that develop purposefully vague standards that suit the economic interests of the private actors (Veale, 2020). Similarly, principled approach to AI self-regulation based on high-level concepts of fairness, equality or accountability may be flexibly interpreted to accommodate achieving corporate goals and ultimately serve profit-seeking interest while propagating "responsible" image to the public (Krafft *et al.*, 2020; Mittelstadt, 2019; Ulbricht and Yeung, 2021). If adherence to these principles remains voluntary and the possibility to administer a sanction for a professional misconduct is missing, continued reliance on self-governance alone without legal punitive mechanisms is unsustainable in the long run (Mittelstadt, 2019). As regards top-down legislation, most countries still lack specific BDA regulation, and many of the problems stemming from companies' data collection and processing activity are addressed by the existing consumer protection, privacy or anti-discrimination laws that were developed in the pre-digital era (Finck, 2018). For instance, the United States does not have a single data protection legislation, and personal data of its citizens is protected through a "patchwork" of federal, state and sector-specific laws focused on particular categories of personal information such as Children's Online Privacy Protection Act (COPPA), Health Information Portability and Accountability Act (HIPAA) or Video Privacy Protection Act (VPPA).

As questions of adapting existing legal frameworks to the new realities started to emerge, countries started to introduce new regulatory initiatives to impose legal obligations on the companies. In this regard, European Union (EU) regulatory activity has been most prominent and has been considered an advanced "standard" in a new generation of data protection laws that regulators in other countries should follow. In 2018, EU General Data Protection Regulation (GDPR) has gone into effect to grant more individual rights for citizens and impose stricter rules on companies to ensure individual privacy and personal data protection of their data subjects (e.g., users). In April 2021, European Commission has published a proposal of Artificial Intelligence Act (AI Act) which intends to prohibit application of unacceptable-risk AI software on the EU territory and to impose additional disclosure and transparency requirements on the companies that use AI systems categorised as high- and low-risk. Within EU data-related regulation, calls for accountability often reveal the tensions "about how to reconcile economic incentives to create a frictionless digital single market with rights-based arguments for restricting data flows to protect citizens' privacy and dignity" (Cool, 2019). In response to these concerns, the EU has developed the Digital Single Market strategy and has initiated a suite of laws including the Data Act, Data Governance Act,

Digital Markets Act, Digital Services Act and the aforementioned GDPR and the AI Act. In doing so, the EU demonstrates its commitment and determination not only to protect data of its citizens but also to allows for inter-organisational data flows and transparency in data sharing for public interest, innovation and societal value creation.

This chapter provides an overview of the legal frameworks and regulatory developments in the EU with regards to the data collection, use, storage, processing and sharing. The chapter concludes by critical assessment of the effectiveness of the current regulation in reaching its goals and its implications for organisations, managerial decision-making and accounting.

3.2. General Data Protection Regulation (GDPR)

3.2.1. *General overview*

This section reviews the aspects of the General Data Protection Regulation which are considered relevant for the purpose of accounting. The discussion of the regulation in all its entirety is out of the scope of this manuscript.

Regulation (EU) 2016/679 (General Data Protection Regulation, or GDPR) represents an effort to harmonize data privacy laws across all EU member states and is applicable in the EU as of May 25th, 2018. GDPR replaces the older Data Protection Directive 95/46/EC (repealed on May 24th, 2018) on the protection of individuals regarding the processing of personal data and on the free movement of such data. The objectives of the GDPR are to ensure fundamental rights of natural persons for protection of their personal data despite the increased scale of personal data processing and sharing while at the same time to facilitate secure free flow of personal data within the EU as well as across EU borders to the non-EU countries and international organisations. Moreover, the GDPR presents an effort to harmonize the laws of the different EU member states regarding personal data protection and to merge them in one single law. The GDPR consists of 99 articles which must be followed by organisations to be compliant and 173 recitals which represent non-binding guidelines and supplementary information.

The material scope of the GDPR relates to the *personal data* – that is, "any information relating to an identified or identifiable natural person ('data subject')". Limiting the scope of the GDRP to natural persons implies that data about companies and legal entities (or legal persons) is not considered personal data and therefore is not regulated by the GDPR.

A natural person is considered *identifiable* if it can be identified, directly or indirectly, by reference to his or her name, identification number (e.g., ID card

number), online identifiers (e.g., IP address), location (e.g., geolocation, address), biometric data (e.g., facial images, fingerprints) or any other factor that can reveal the identity of the natural person. Information can come in different formats such as video, audio, image, numerical data. The GDPR applies to personal data which is processed "wholly or partly by automated means" (e.g., through a digital interface) or processed in a non-automated way (e.g., manual records) but makes a part of a "filing system" (GDPR, Art. 2).

GDPR applies only to information that concerns identified or identifiable natural person (GDPR, Recital 26). In this regard, some elements of the law are derogated (or partially supressed) if data controllers apply "de-identification techniques" such as anonymisation and pseudonymisation (Andrew and Baker, 2021). Information is defined as *anonymous* if it "does not relate to an identified or identifiable natural person or to personal data rendered anonymous in such a manner that the data subject is not or no longer identifiable" (GDPR, Recital 26). Consequently, the GDPR explicitly states that it does not apply to processing of anonymous information (GDPR, Recital 26). Therefore, anonymisation of data presents an option for data controllers and processors to release themselves from an obligation to abide by the GDPR requirements.

Pseudonymization is defined as "the processing of personal data in such a way that the data can no longer be attributed to a specific data subject without the use of additional information" (GDPR, Art. 4.5). Under the GDPR, the main difference between anonymised and pseudonymised data resides in the "irreversibility" of the former. While anonymous information is obtained by deleting all personal information that can be traced back to a person, pseudonymisation implies that additional personal information is stored "separately and securely" but is not destroyed (Andrew and Baker, 2021). Therefore, there is always a risk that pseudonymised data can be combined and triangulated with other pieces of seemingly innocuous information to eventually identify a person. According to Recital 26, pseudonymised data which can be attributed to a person by putting together personal and additional information, "should be considered to be information on an identifiable natural person" but allows for relaxation of some GDPR principles which will be discussed below.

The territorial scope of the GDPR has a "long-arm" jurisdiction which implies that it applies to any company that is involved in processing the personal data of EU data subjects, regardless of whether the company is established in the EU (or not) and whether data is processed in the EU or not (GDPR, Art. 3). For example, even if a company established in the United States but offers products or services to or monitors behaviour of data sub-

jects in the EU (customers or employees), it falls under the EU regulatory oversight of GDPR.

A term *processing* is defined as any operation on personal data, performed in automated manner or not, including "collection, recording, organisation, structuring, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, restriction, erasure or destruction" (GDPR, Art. 4.2). Processing covers a broad range of data-related activity such as use of data, collecting it for storage, data mining, creating big data sets for training AI algorithms. To that end, the GDPR distinguishes between a controller and a processor.

A *controller* is defined as a natural or legal person which "determines the purposes and means of the processing of personal data". Accordingly, a *processor* is natural or legal person that "processes personal data on behalf of the controller". Under the GDPR, data controllers are required to adopt compliance measures and ensure that data subjects' rights are upheld. Data processors are obligated to take "technical and organisational measures" to process personal data in a secure way that will meet the requirements of the GDPR (GDPR, Art. 28). Considering that the GDPR establishes different set of obligations for processors and controllers, it is important for companies to understand which category they belong to or whether they can be classified as both categories simultaneously. For example, Facebook is a company that operates both as a controller and a processor. In most instances, Facebook acts as a data controller when handling personal data of the user's on-platform activity (e.g., Facebook Messenger). At the same time, Facebook acts as a data processor on behalf on other businesses and advertisers that act as controllers (e.g., advertising campaigns analytics, Custom Audiences and Workplace Premium features) [1]. The GDPR reaffirms that a controller is a party primarily responsible for data and imposes stricter controls and obligations on the data controllers than it does on processors (Hoofnagle *et al*., 2019).

The law also establishes substantial penalties for non-compliance. According to Article 38, a company may be fined of up to €20 million or 4% of a company's annual global turnover (whichever is greater) for breaching of the GDPR (Akhlaghpour *et al.*, 2021).

[1] Meta Official website. What is the General Data Protection regulation (GDPR)? Retrieved 05/12/2022 from https://www.facebook.com/business/gdpr.

3.2.2. *Data processing principles*

This section outlines the main underlying principles of the GDPR which companies should take int account when carrying out their personal data processing activities. The seven principles of data protection are outlined in the Article 5 of the GDPR.

Lawfulness, fairness and transparency principle implies that processing of personal data of must be done in a manner which is lawful, fair and transparent to the data subject. Put simpler, the principle suggests that a company must clearly communicate to the data subjects what kind of personal data it will collect and for which [lawful] purpose. In practice, this implies that companies need to devise a privacy policy which will inform their data subjects about what data is collected, how it will be used and why it needs to be collected as well as provide comprehensive information about the data subject can exercise their rights in regard to their personal data collected. Lawful data processing means that (1) data processing must be consent-based and (2) legitimate interest-based processing. The former condition implies that a data subject must explicitly consent to her data being processed. The latter condition means that rights if the data subject are favoured above corporate and business objectives (Buttarelli, 2016).

Purpose limitation principle implies that personal data must be collected to achieve a legitimate and concrete purpose and should not be processed for the purposes which do not comply with the one originally specified. In practice, this principle implies that companies should be explicit about the purpose of data processing upfront ("say what you do" in privacy policy) and should not process collected data for the "new" purpose which was not originally communicated to the data subjects ("do what you say"). As Zarsky (2017, p. 1006) argues, compliance with the purpose limitation principle obliges companies to "inform their data subjects of the future forms of processing they will engage in (which must still be legitimate by nature) and closely monitor their practices to assure they do not exceed the permitted realm of analyses." Pseudonymisation provides an exception for the principle of purpose limitation (Andrew and Baker, 2021). According to Art. 6.4, pseudonymised data can be processed for uses "beyond the purpose for which the data was originally collected". In practice, relaxation of this principle for pseudonymised data is appealing for companies because it allows data controllers to have greater regulatory flexibility while still maintaining control over storing and processing personal data (Andrew and Baker, 2021).

Data minimisation principle implies that personal data should be collected only to the extent it is needed to achieve the purpose. In other words, this

principle aims to limit data collection only to "what is necessary" and thereby constrains the possibilities of firms to "undermine the data protection rights of their data subjects" (Andrew and Baker, 2021). In practice, this means that companies should avoid purposelessly collecting data just because they technically can do so with the hope to figure out what to do with it at a later point. Not only such behaviour would be inconsistent with the data minimisation principle, but it also may create operational hazards as the company wastes resources (e.g., energy, water) to collect and store data which is not used (Corbett, 2018) and increases exposure to security risks (La Torre *et al.*, 2018).

Storage limitation principle implies that personal data should not be stored longer than it is necessary for achieving the specified purpose. The exceptions are the data which are processed for archival, statistical or research purposes. While the storage limitation principle is conceptually similar to that of data minimisation, the main difference between the two is that data minimisation imposes limits on the *type* of data that can be collected, the storage limitation is of temporal nature and limits the *length* of the period for which the data can be stored (Andrew and Baker, 2021).

Accuracy principle implies that data should be kept up to date. Inaccurate or obsolete data needs to be erased "without delay".

Integrity and confidentiality principle implies that organisations need to take technical and organisational measures to ensure "appropriate security" of personal data and take active steps to prevent "unauthorised or unlawful" access and protect against "accidental loss, destruction or damage" of personal data (Art. 5.1). GDPR formulates its recommendation in terms of "appropriate" security measures adoption and leaves it up to organisations to carry out a risk-based assessment to determine how security levels differ depending on the degree of sensitivity of personal data.

Accountability principle implies that controller needs to demonstrate compliance to all abovementioned principles. In this regard, accountability principle ensures that the burden of assessing the lawfulness and fairness of data processing practices is placed on data controllers, not on data subjects. However, accountability does not equate to mere compliance with the GDPR law (Buttarelli, 2016). To that end, accountability should be understood as an ethical responsibility of the businesses and regulators to commit to sustainable data processing.

The seven principles of GDPR are summarized in Table 2.

Table 2. – *Summary of the GDPR principles*

Principle	Description
Lawfulness, fairness and transparency	A company must use **lawful methods** for data processing and **clearly communicate** to the data subjects what kind of personal data it will collect and for which [lawful] purpose
Purpose limitation	Personal data must be collected to achieve **a legitimate and concrete purpose** and should not be processed for the unspecified purposes
Data minimisation	Personal data should be collected **only to the extent it is needed** to achieve the purpose
Storage limitation	Personal data **should not be stored longer than it is necessary** for achieving the specified purpose
Accuracy	Personal data should be kept **up to date and accurate**
Integrity and confidentiality	A company needs to take technical and organisational measures to **ensure "appropriate security"** of personal data and take active steps to **prevent "unauthorised or unlawful"** access and **protect against "accidental loss, destruction or damage"** of personal data
Accountability	A company needs to **demonstrate compliance** to GDPR principles

3.2.3. *Rights of data subjects*

Right to erasure (or *right to be forgotten*, GDPR, Art. 17). The precedent for the right to be forgotten was originally set by the decision of the Court of Justice of the European Union (CJEU) against Google taken in May 2014. The background of the case Google Spain SL, Google Inc. vs. Agencia Española de Protección de Datos (AEPD) and Mario Costeja González regards La Vanguardia newspaper article about an auction notice and the debt proceedings against Mr. Costeja González in 1998. Although the debts have been later paid, running a Google search on Mr. Costeja González name continued to return a link to the aforementioned article in search results (Chenou and Radu, 2019). Google initially declined Mr. Costeja González request to delink the article. Even though appearing in Google search results increases public exposure of personal information significantly beyond that of an individual newspaper website, Google has argued that it was not in control of that data and that the Spanish newspaper publisher, as a party that created and published the article, was in control of that data instead. However, the CJEU disagreed and has concluded the Google search engine to be a "data controller" which entails having liability for processing online content (Kelly and Satola, 2017). Google's

activity "consisting in finding information published or placed on the internet by third parties, indexing it automatically, storing it temporarily and finally, making it available to internet users according to a particular order of preference" was classified as "processing of personal data" [2]. While the ruling took place before the adoption of the GDPR, this case marks the first time when an individual user was able to successfully "delink" the search engine results against their name.

The GDPR (GDPR, art. 17) legally establishes the right of a data subject to demand for their data to be deleted and the controller has an obligation to do so if certain conditions are fulfilled. This right is typically exercised when data subjects no longer consent to processing, when data has errors or if data subject believes that storing personal information is no longer necessary for the purpose for which it was originally processed. The type of data which is usually requested to be "erased" are photos, outdated newspaper articles, past references to legal proceedings or criminal convictions. GDPR critics argue that without proper thresholds the right to be forgotten might amount to "rewriting history" and emphasize its inherent conflict the freedom of speech (Kelly and Satola, 2017). In that sense, the right to erasure is *not* an absolute right and may be overridden by an organisation's right to process data, especially in cases when the data is used "to exercise the right of freedom of expression and information", the data is processed for public interest, research or statistical purpose, the data is used to "comply with legal obligation" or "establishment, exercise or defence of legal claims" (Art. 17).

Right of access (GDPR, Art. 15) is closely related to the right to erasure. In this case, the GDPR grants data subject the right to ask the data controller to confirm whether her data are being processed and, if so, access her personal data and additional information. In essence, the right allows the individual to request what personal data does the organisation hold. The requested information may include but is not limited to the purpose of data processing, categories of data collected, recipients of data, duration of the data storage period. The data subject may only request to access their personal data. Once the company receives the request to access, it should respond to the inquiry within 30 days and cannot alter data in any way by either deleting, withholding, or editing the data (Sørum and Presthus, 2020).

Right to rectification (GDPR, Art. 16) is aligned with the Accuracy principle of the GDPR and obliges the data controller to rectify inaccurate personal information or complete personal data records "without undue delay" if the

[2] Court of Justice of the European Union. (2014, May 13). *Google Spain SL, Google Inc. v. Agencia Española de Protección de Datos (AEPD), Mario Costeja González.* C-131/12.

data subject has requested to do so. To that end, Art. 16 allows the users to have their data corrected.

Right to restriction of processing (GDPR, Art. 18) allows data subjects to contest how their data are being used. Based on this right, when data subjects request data controllers to restrict processing under certain conditions (for example, when data processing is unlawful or when data accuracy needs to be verified), the GDPR limits the ability of the controller to process the data but does not require the controller to delete personal data in question. Restriction of processing may take place via temporally removing the personal data from the website or making it unavailable to the users (recital 67). In this case, data subjects might favour exercising the right to restriction of processing as opposed to the right to erasure considering that they still be interested in keeping personal information accessible for various reasons (Kuru and Beriain, 2022).

Right to data portability (GDPR, Art. 20) has been first introduced by GDPR and was not present in the Data Protection Directive 95/46/EC. The GDPR states that a data subject has a right "to receive the personal data […] in a structured, commonly used and machine-readable format" and "to transmit those data to another controller", whether the latter usually relates to another company. To that end, the controller to which the personal data was originally provided by the data subject, should not hinder the data transfer in any way. The request can be met either by sending the data to the data subject directly or by creating an automated interface though which a user can extract personal data independently (Sørum and Presthus, 2020). Since the right to data portability allows individuals to receive their data from an organisation and transfer them elsewhere, it prevents "lock-in" situations when a user is unable to leave a platform or move to a different digital service or application because their personal data cannot be transferred to another organisation.

Right to object to automated decision-making, including profiling (GDPR, art. 22) legally allows an individual to *not* be a subject of fully automated processes that have a substantial impact on the individual, such as recruitment, credit applications or criminal sentencing decisions (Martin, 2019; Zarsky, 2017). This right can be also applied to profiling in that automated marketing can be rejected by the user. The law does not apply is the decision is based on the explicit consent of the data subject (Art. 22.2(c)). This regulation has existed also in the previous Data Protection Directive 95/46/EC but the importance of this right has increased substantially over the last decades with proliferated use of ML/AI algorithms in automated processes which were previously performed by a human decision-makers. When facing automated deci-

sions, a data subject is granted a right to "obtain human intervention" and to "contest the decision" (art. 22.3).

Right to explanation (GDPR, art 15.1(h)) is related to the right to object to automated decision-making. It is noteworthy that Art. 22 does not explicitly require the data controller to provide explanation of an automated decision to an individual (Gryz and Rojszczak, 2021). Instead, Art 15.1(h) imposes an obligation on data controllers in case of automated decision-making to grant a data subject access to "meaningful information about the logic involved, as well as the significance and the envisaged consequences of such processing for the data subject".

3.2.4. *GDPR compliance obligations*

This section reviews a subset of most prominent GDPR compliance obligations that require companies to revisit their data-related process, data governance structures, risk assessment and reporting practices. The discussion of the remaining obligations is out of the scope of this manuscript.

3.2.4.1. *Consent-based data processing*

Most companies situated in the countries outside the EU address user privacy and informed consent using a so-called "opt-out" (or "notice and choice") approach which allows for "passive" consent "*though a company's terms of service of the privacy policy published on its website*" (de Matos and Adjerid, 2022, p. 3331). In practice, opt-out approach implies that a company may refer a user to its privacy policy (*notice*) and inform the user about the possibility to "opt out" if she disagrees with how her personal data is collected and used (*choice*). While in theory providing users with a notice and a choice should allow them to control and select privacy protections according to their own preferences, in practice such approach has been criticised for the lack of transparency and "default" consent choices that allowed companies to collect personal data without the users' knowledge and to use for purposes that go beyond the agreed-upon conditions of use (Pascalev, 2017). Furthermore, Pascalev (2017) argues that consenting to the terms and conditions of current privacy statements does not constitute an informed consent as users rarely read and understand the convoluted legal jargon that is used in them.

By contrast, GDPR requirement of "enhanced" consent places the burden of proof of the data subject's consent to personal data processing on the data controller (Tikkinen-Piri *et al.*, 2018) and is aligned with the "opt-in" ap-

proach (de Matos and Adjerid, 2022). Opt-in approach implies that users should explicitly agree to a business to process their personal data for specific purposes and can opt out if they no longer want their data to be processed. Conditions for consent are outlined in Art. 7 of the GDPR. Article 4.11 of the GDPR defines consent of a data subject as "*any freely given, specific, informed and unambiguous indication of the data subject's wishes by which he or she, by a statement or by a clear affirmative action, signifies agreement to the processing of personal data relating to him or her*".

To that end, "*freely given*" consent means that it is *voluntary* in nature. For example, consent is not freely given if there is a clear power imbalance between data subject and data controller (GDPR, Recital 43). Moreover, consent is not considered to be freely given if the data subject does not have a choice such as in situations when the provision of service is conditional on consent to the personal data processing (other than those necessary for the service provision) and users have no option *not* to consent if they intend to proceed with using the service (Daśko, 2017). "Specific" implies that consent should be given in relation to a specific purpose of data processing. That is, if a business intends to use personal data for several different purposes, consent should be solicited from users about each specific use and consent should be "clearly distinguishable" from other matters (e.g., service contracts) (Tikkinen-Piri *et al.*, 2018). "Informed and unambiguous" condition implies the use of plain and easy to understand language as well as clarity and transparency for the data subjects regarding who is collecting what personal data, for how long and for which purpose, how it will be processed and how secure is it (de Matos and Adjerid, 2022). Finally, "a clear affirmative action" precludes the use of consent "through silence, pre-ticked boxes or inactivity" (GDPR, Recital 32). To sum up, GDPR requires companies to obtain consent from a data subject for the personal data processing to be lawful. However, "passive" consent solicited by coercing the user to default acceptance of the company's complex privacy policy is not valid under the GDPR. Therefore, the GDPR will require businesses to redesign their consent mechanisms and rethink their internal data processing operations to ensure compliance.

3.2.4.2. *Data protection by design and by default*

In accordance with the GDPR, the data controller is required to implement "appropriate technical and organisational measures" and to so "both at the time of the determination of the means for processing and at the time of the processing itself" (GDPR, Art. 25). In essence, this requirement implies that the principles of data protection and privacy should be integrated as *default*

option in information systems architectures, technology products and business operations starting early-on at the design stage and implemented throughout the lifecycle of personal data management (collection, processing, and deletion) (Jasmontaite *et al.*, 2018). The requirement rests on the seven principles such as (1) proactive and preventive approach to privacy, (2) full functionality of a product, (3) privacy by default, (4) lifecycle data protection, (5) transparency, (6) privacy embedded into design, and (7) respect for user privacy (Cavoukian, 2009). While legislation does not specify the exact measures and "safeguards" that companies need to take to ensure this obligation is met (except for pseudonymisation, encryption and anonymisation), research emphasizes the role of organisational commitment to privacy, company-level awareness raising and corporate adherence to the ethical of data related organisational practices (Arthur and Owen, 2019; Tikkinen-Piri *et al.*, 2018).

An example of what does *not* constitute a privacy by design and default approach appears useful at this point. Nest Labs was founded in 2010 and is primarily known for its Nest Learning Thermostat – a sensor-driven device embedded with wireless internet connectivity and powered by machine learning algorithms. The Nest thermostat is a "smart" home device that can automatically adjust room temperatures or send notifications to homeowners, but it can also collect data about homeowners' behaviours and can gather data from other sensor-equipped products such as wearable fitness trackers, consumer appliances and cars (Zuboff, 2019). After having been acquired by Google in 2014, Next was run as a standalone business unit until February 2018 when Alphabet has merged its Google and Nest divisions together as a part of its restructuring. The merger sparked concerns about the use of personal data by Google for its economic benefit (Zuboff, 2019). Furthermore, consumers became increasingly worried about the privacy and security of personal data that can be shared across the entire IoT ecosystem of Nest's supply chain partners such as cloud providers, energy companies, credit card processing services without their awareness (Noto La Diega and Walden, 2016). However, to get information about their rights and the manufacturer's obligations, an average consumer would have to read at least 13 legal documents for Nest thermostat and, if one would consider legal documentation of each of the connected devices and apps in the ecosystem, the list might easily amount to a thousand of different contracts (Zuboff, 2019). Furthermore, if customer disagreed with any of the provisions in a legal document, it was offered to "cease accessing or using product software" as an alternative (Noto La Diega and Walden, 2016).

In sum, the example illustrates how the manufacturer obfuscated the pur-

poses and the scope of personal data collection by making user consent to an incomprehensible set of legal documentation (violating transparency and respect for user privacy principles), deprived the customer of using the full product functionality in case consent was withdrawn (violating full functionality principle), shared personal data across multiple devices with third parties (violating lifecycle data protection) and used personal data to provide targeted ads (violating privacy by default principle). To prevent these issues arising moving forward, GDPR encourages companies to start treating privacy as an "essential component of the core functionality being delivered" (Cavoukian, 2009, p. 3).

3.2.4.3. *Data breach disclosure*

Breach of security is defined as an event that "leads to the accidental or unlawful destruction, loss, alteration, unauthorised disclosure of or access to personal data that is transmitted, stored or otherwise processed" (Tikkinen-Piri *et al.*, 2018, p. 139). For organisations, data security breach involving customer data carry substantial risks for their reputation, competitive position, brand image, customer and stakeholder relationships and, ultimately, financial profitability (Chiusa, 1987). Therefore, organisations have been traditionally reluctant to disclose their data security incidents and preferred to keep data breaches secret from the public eye (La Torre *et al.*, 2018). Yet, as the collection of personal data continues to grow at scale and as data breaches are increasingly becoming a frequent occurrence, there is a need for enhanced organisational accountability and more transparency of risks related to personal data processing (Andrew *et al.*, 2021).

In this regard, the GDPR imposes new obligations both on the controller and the processor to provide notification about personal data breach (Tikkinen-Piri *et al.*, 2018). To that end, the data controller should notify the supervisory authority no later than 72 hours after becoming aware of the data breach (GDPR, Article 33). Accordingly, the processor is obliged to notify the controller of a personal data breach "without undue delay" (GDPR, Article 32). When the breach is considered high-risk for personal data privacy and security, the GDPR also stipulates that the controller is required to communicate the event of the personal data breach to the data subject "without undue delay" and "in clear and plain language" (GDPR, Article 34). However, if the data controller has subsequently implemented "remedial" measures to prevent the privacy risks from materialising, notifying the data subject is not required.

In sum, data breach disclosure requirement upholds the data subjects' "right to know" about data-related risks and provides additional incentives to improve data security and privacy measures, both on individual and organisational levels (Nieuwesteeg and Faure, 2018). However, in the event of the data breach, the GDPR still prioritises notifying the authorities over notifying the concerned individual. Furthermore, the law does not mandate the information about the breach to be disclosed publicly, thereby precluding public debates about the magnitude of issues related to compromised data security and constraining the ability of the public to demand greater transparency and data-oriented forms of accountability (Andrew *et al.*, 2021).

3.2.4.4. *Appointing Data Protection Officer (DPO)*

The GDPR requires public and private organisations that process personal data at scale or process sensitive personal data to appoint a Data Protection Officer (DPO) (GDPR, Article 37). DPO is tasked with informing, training and advising the members of an organisation about GDPR obligations, auditing and monitoring compliance with GDPR provisions (GDPR, Article 39). At the same time, DPO serves as a liaison with the supervisory authorities and a point of contact for the data subjects. As such, the DPOs can be viewed as a party acting on behalf and in the interest of the Data Protection Authorities, but "appointed and paid for by the data controllers themselves" (Hoofnagle *et al.* 2019, p. 86). DPO may be either a staff or a contractor but should be an independent party that reports directly to top management and must be "shielded" from being penalised or dismissed for her activity (GDPR, Article 38 and 39).

3.2.4.5. *Data protection impact assessment (DPIA)*

The GDPR imposes a legal obligation to carry out Data Protection Impact Assessment (DPIA) in case of high-risk personal data processing. According to Article 35, three types of data processing are classified as "high-risk": (1) "systematic and extensive evaluation of the personal aspects" is based on profiling or other automated means and its outcomes are material to people (a bank plans to implement an automated credit system based on client profiling, (2) "processing of sensitive data on a large scale" (a hospital plans to implement health information system based on its patient health data) and (3) "systematic monitoring of public spaces on a large scale (an airport plans to install a video surveillance security system). The DPIA is required to assess the necessity and proportionality of the data processing operations, evaluate the re-

lated risks to the rights and freedoms of the data subjects and to describe appropriate measures to address these risks.

3.2.5. *Analysis and critique*

Although not explicitly stated in the law, one of the objectives of the GDPR is to update and adapt EU data-related regulations to the contemporary methods in data collection and processing, such as big data, cloud computing and AI/ML and protect the EU citizens from the new risks and threats that emerge in the digital era because of the fast-paced technology development and cross-border data transfer (Gryz and Rojszczak, 2021). To that end, the GDPR presents an important regulatory milestone towards making organisations involved in data processing more accountable (Hoofnagle *et al.*, 2019). In essence, introducing the new user rights such as the right to data portability and extending certain rights such as a right to object to automated decision-making (Art. 20) or a right to explanation (Art. 15.1(h)) signal an intent to allow individuals to regain some of the control over their personal data and promote competition by limiting the power of the monopolies in the data market.

Yet, researchers are in dispute with regards to whether this objective has been achieved. To that end, Zarsky (2017, p. 996) asserts that "GDPR's enactment could substantially alter the way Big Data analysis is conducted" and "will do so while stalling innovation in Europe and limiting utility to European citizens, while not necessarily providing such citizens with greater privacy protection".

For example, with regards to purpose limitation principle, the proposed counter argument is that users have already surrendered control over much of their personal information in exchange for convenience and free services, and the GDPR can be viewed as a "paternalistic" attempt of the state to provide individuals with rights they do not necessarily require (Zarsky, 2017). Research has shown that users are concerned with the lack of transparency in data collection but perceive any attempt to exert control over data collection and use as futile (Leszczynski, 2015).

As regards promoting the competition, Zarsky (2017) argues that purpose limitation blocks any "unforeseen" analysis *ex ante* and can achieve the opposite results and instead further strengthen the positions of the data monopolies and undermine the abilities of startups to access secondary data or use existing data to explore new business opportunities. Similarly, data minimisation principle has been found to be at odds with BDA practices as it limits the possibilities to generate new knowledge and make new inferences. Possible "safeguards" that relax these principles – such as the pseudonymization already

mentioned earlier – can partially alleviate these concerns but are complex to implement and can negatively impact the precision and accuracy of data processing (Zarsky, 2017).

Probably most of the criticism relates to the automated decisions and the "right to explanation" that is granted to individuals. To that end, research offers several explanations of why exercising this right might be infeasible and problematic in practice. First, making an algorithmic system interpretable often implies sacrificing its complexity in part and, consequently, compromising its accuracy and precision (Kearns and Roth, 2019). Zarsky (2017) argues that disclosure of the logic of the algorithm will require that big data analytics is done in a way that the process is interpretable and can be explained to an individual that has exercised her "right to explanation". Second, disclosing the logic of an algorithm only makes sense if it can be comprehended by the inquiring individual. Considering that some parts of an algorithm are not known even to IT professionals that are involved in development of an algorithmic model, one cannot expect an uninformed individual without technical background to be able to understand and evaluate its properties (Kemper and Kolkman, 2019). Third, companies will be reluctant to disclosure the inner workings of their algorithms to protect their "trade secrets" and sustain their unique competitive advantage on the data processing market (Hansen and Flyverbon, 2016). Fourth, when advanced, autonomous self-learning AI/ML algorithms are underlying automated decision-making, interpreting its algorithmic steps becomes technically impossible (Kroll *et al.*, 2017) because "within code, algorithms are usually woven together with hundreds of other algorithms to create algorithmic systems" (Kemper and Kolkman, 2019, p. 2091). Therefore, one can interpret the "right to explanation" as a sign of "distrust" in automated processes and will require companies to compromise the efficiency of their processes in order to comply with this rule.

Finally, it is important to underline personal data still can be involved even when the data is anonymous. This is the case when an individual's anonymous information is combined and matched with other information sources, especially considering the ability of advanced BDA techniques to triangulate seemingly unrelated data sources and find patterns in data. However, such datasets fall outside of GDPR scope (Hacker, 2020).

3.3. Digital Services Act (DSA)

3.3.1. *Background*

Disinformation and fake news that exploit user emotional responsiveness are a source of concern that casts some doubts on whether these are undesirable and inevitable by-products of digital platforms or key elements of their business and revenue models (Trittin-Ulbrich *et al.*, 2020). Moreover, the growing importance of online marketplaces like Zalando and Amazon has raised additional concerns about consumer protection and the extent to which the current regulation enables holding online market intermediaries liable for their wrongdoings (Duivenvoorde, 2022). Until recently, the primary law for intermediary regulation in the EU has been the e-Commerce Directive (Directive 2000/31/EC, Articles 14 and 15) which exempted intermediaries from an obligation to monitor user-generated content as long as they do not know about illegal activity and act promptly once notified about it (Heldt, 2022). This liability exception for content moderation coupled with overall "non-interventionist" regulatory approach in the digital market has not been effective in increasing companies' accountability and responsibility (Savin, 2021). Following the alleged voting manipulations by Facebook and Cambridge Analytica during the UK Brexit campaign, single EU Member states have independently initiated adoption of the new laws against information manipulation and unlawful content, such as the Network Enforcement Act (NetzDG) in Germany or a law against information manipulation in France (Heldt, 2022). To that end, the Digital Services Act seeks to harmonise national legislation in this regard and update pre-existing rules on digital platforms by means of revisiting the legal approach enacted by the e-Commerce Directive.

3.3.2. *General overview*

The Digital Services Act (DSA) is a new digital services regulation in the EU passed on July 5, 2022. The DSA includes obligations proportionate to the size of the platform and a new culture of preventing systemic risks, from misinformation to illegal content. The DSA entered into force on November 16th, 2022 and will be applicable in the EU member states from 2024. The DSA is a horizontal regulation that applies to all industry sectors and applies to companies that provide their digital services to EU citizens (Husovec and Roche Laguna, 2022).

The core objective of the DSA is to ensure "a safe, predictable and trusted online environment" (Article 1(1) DSA), protect fundamental rights of online

users by addressing societal risks generated as a result of dissemination of illegal content online and disinformation (DSA, 2022). The DSA provides examples of illegal content (hate speech, terrorist content) and illegal activity (unlawful non-consensual sharing of private images, selling of counterfeit goods, non-authorised use of copyright protected material).

According to Articles 1(4) and 2(f), the regulation applies to intermediaries, defined as "mere conduit", caching and hosting services. Importantly, mere conduit companies that provide "technical, automatic and passive role" are fully exempted from the liability (Buiten, 2022). The DSA preserves the liability exemptions also for caching and hosting companies on condition that they "do not have actual knowledge of illegal activity or content" or "act expeditiously to remove or disable access to the illegal content" upon becoming aware of the fact (Table 3).

Table 3. – *Liability exemptions for different categories of intermediaries according to the DSA*

Intermediary services categories	**Definition**	**Examples**	**Liability exemptions in the DSA**
Mere conduit	• Services that transmit information in a "communication framework" or provide access to a communication network	Infrastructure services; internet access providers; WiFi; DNS authorities; messaging apps	not liable for user information *even if they are notified* about illegal content
Caching services	• Services that transmit information in a "communication network" and provide "automatic, intermediate and temporary" storage of information	content delivery networks	not liable for user information *unless they are notified* that the illegal content at the source is removed from the network
Hosting services	• Services that provide storage of the third party information	social networks; content-sharing services; trading platforms; discussion forums; some sharing economy services; cloud services; webhosting services; app stores	not liable for user information *unless they are notified* about the fact of illegal content or activity

The true novelty of the DSA lies in adopting a "layered" approach to the due diligence obligations (Husovec and Roche Laguna, 2022). While regulation broadly applies to all intermediaries, some special categories (e.g., very large platforms, VLOPs) are subject to separate set of more stringent rules and obligations (Savin, 2021). Such asymmetric regulatory approach allows for distinguishing between the platforms of different size and require more from the more powerful market players which are more likely to engage into harmful conduct (Savin, 2021). To that end, the DSA stipulates four different "tiers" of due diligence obligations that map on the four categories of intermediaries (Husovec and Roche Laguna, 2022):

– *Universal obligations* equally apply to all intermediaries (mere conduit, caching and hosting), regardless of the size of the firm (with the exception of annual reporting);
– *Basic obligations* apply only to providers of hosting services, regardless of the size of the firm;
– *Advanced obligations* apply only to a *subset* of hosting services, i.e. online platforms and marketplaces that qualify as medium-sized or larger enterprises according to Recommendation 2003/361/EC;
– *Special obligations* apply to online platforms and search engines that are qualified as "very large" (VLOPs or VLOSE, respectively) if their reach exceeds 45 million monthly average active users in the EU.

The types of obligations are summarized in Table 4.

Table 4. – *Layered approach to due diligence obligations according to the DSA*

Obligations	Scope	Types of obligations	Reference in the DSA	Notes
Universal	All intermediaries, regardless of their size	– Points of contact for supervisory authorities and direct user communication – Designating a legal representative in a EU Member State – Terms and conditions – Transparency reporting obligations (annual reports)	Chapter III, Section 1, Articles 11 though 15	– Terms and conditions should disclose content moderation policies, algorithmic decision-making, and complaint handling – Annual report on content moderation activities should be publicly available and include specific quantitative information on the number of notices/orders – Micro and small enterprises are exempted from annual reporting obligation
Basic	Hosting companies, regardless of their size	In addition to the universal obligations, the following apply: – Notice and action mechanisms – Statement of reasons – Notification of suspicious criminal offences to law enforcement	Chapter III, Section 2, Articles 16 though 18	– User-friendly submission mechanism of illegal content notice – Provide reasons for restricting visibility (suspension/termination) to any affected user

Segue

Advanced	Online platforms (a subset of hosting companies employing more than 50 persons and annual turnover/annual balance sheet total exceeds €10 million)	In addition to the basic obligations, the following apply: – Internal complaint-handling system – Out-of-court dispute settlement – Trusted flaggers – Measures and protection against misuse – Additional transparency reporting obligations – Online interface design and organisation – Advertising on online platforms – Recommender system transparency – Online protection of minors	Chapter III, Section 3, Articles 19 though 28	– Online platforms are hosting companies that publicly disseminate users' information (social networks, content-sharing, online travel and accommodation websites, marketplaces) – Prohibits using deceiving or manipulative techniques in interface design – Annual reports should include number of disputes and their outcomes and number of suspensions for provision of illegal content or submission of unfounded complaints – Proper labelling of advertising – Transparency of parameters used in recommender systems
Special	VLOPs and VLOSEs with more than 45 million average monthly users, regardless of turnover and headcount	In addition to advanced obligations, the following apply to VLOPs: – Risk assessment	Chapter III, Section 5, Articles 34 though 43	– Designation of online platform as VLOP/VLOSE is performed by European Commission and is

Segue

		– Mitigation of risks – Crisis response mechanism – Independent audit – Recommender systems – Additional online advertising transparency – Data access and scrutiny – Compliance function – Additional transparency reporting obligations – Supervisory fee VLOSE are subject to Special obligations only		published in the Official Journal of the EU – Systemic risk assessment with regards to illegal content and conduct, negative effects on human rights, civic discourse, electoral process and public security and risk mitigation measures – Risk reports are subject to an independent audit which evaluates compliance with all due diligence obligations – Annual reports should include information about human resources involved in content moderation

Penalties for violations of the DSA can be up to 6% of total annual revenue, and recipients of digital services can seek compensation for damages or losses incurred as a result of violations by the platforms.

To sum up, the DSA separates the liability for illegal content from the due diligence obligations and balances "liability assurance" with societal responsibility to create a safe and fair online environment. Meeting or violating these obligations does not influence the liability exemption of a company but implies that "even the providers who are not liable for users remain accountable for their own failings to be diligent" (Husovec and Roche Laguna, 2022, p.1). Due diligence obligations are concerned more with a process and design rather than content *per se* and impose greater transparency requirements on the companies. Increased level of disclosure can serve as a basis for stakeholder complaints and dialogue and is, therefore "serving not only transparency but also accountability" (Heldt, 2022).

3.3.3. *Analysis and critique*

The novelty and regulatory contribution of DSA lies in breaking the long-standing dichotomy between imposing a duty of care (for third party content moderation) and preserving a liability exemption. To that end, the DSA seems to combine liability exemptions with clear obligations to ensure fair, responsible and transparent process and design (Husovec and Roche Laguna, forthcoming). Another advantage of the DSA is the flexibility of the "layered" or "tiered" approach that accounts for the fact that platforms of different scope and importance should be handled differently (Savin, 2021). Finally, DSA has integrated the long-standing concerns of academics regarding subliminal online techniques for behavioural manipulation (Zuboff, 2019) and introduces the ban on these techniques for online platforms.

Several major shortcomings have been mentioned when analysing the DSA and its prospective consequences. First, an obligation to remove *any* content as soon as it is flagged by *anyone* to avoid legal liability for it can be viewed as an arbitrary form of content control and limitation of freedom of expression. Such risks of "collateral censorship" can be aggravated by "over-removal" phenomena when companies prefer to enforce more stringent rules and remove the problematic content outright to avoid legal liability and to save costs of introducing advanced content moderation techniques (Heldt, 2022). As a potential remedy, the DSA requires platforms to work with independent organisations certified by Digital service coordinators for out of court dispute settlement between the platforms and users that believe their content to be wrongly removed. Second, transparency obligations

should be weighed against security risks in that disclosing content moderation mechanisms can be used by bad actors to circumvent the safeguards (Barczentewicz, 2021). Third, arguments have been made that in an attempt to balance out the power structures in the digital economy, the DSA might actually result in giving more legitimacy to the online platforms and lead to further consolidation of the platforms' power over public discourse (Heldt, 2022). Finally, the DSA appears to be "disproportionate" in the scope of reporting obligations which would entail substantial costs for companies to adjust their internal accounting systems to discharge the duty of reporting (Barczentewicz, 2021). Remedies proposed include following de minimis principle which releases companies from a reporting duty if they have nothing or very little report or limit the scope of reporting only to VLOPs which are already reporting some of the required information on a voluntary basis (Barczentewicz, 2021).

3.4. Digital Markets Act (DMA)

3.4.1. *Background*

The digital economy has challenged the functioning of the existing competition law in the EU and has put into question the extent to which it is able to adequately address the harmful conduct of the large technology companies (i.e., "gatekeepers") on the online platform market (Brouwer, 2021). These so-called gatekeepers were shown to exploit inherent characteristics of the digital platform markets – such as low marginal costs, extreme scale economies, network and user lock-in effects, competitive advantages stemming from data ownership – to their advantage which in turn resulted in excessive power being concentrated in the hands of a few large "Big Tech" firms (Ibáñez Colomo, 2021). Taken together, these conditions have led to imbalances in bargaining power between the gatekeepers, business users and end users and to proliferation of unfair practices that have constrained fair competition and innovation in the digital economy sector (DMA, 2022). Until recently, large technology giants as Google, Amazon, Facebook and Apple (GAFA) have been dealt with EU antitrust regulation (Podzun and Bongartz, 2021). Yet, the existing competition law was poorly adapted to tackle the issues as it placed excessive demands on authorities in establishing the fact of infringement, was too slow in adopting decisions and overall lacked effectiveness in counteracting the market power abuse by large digital platforms (Cremer *et al.*, 2019). In this regard, Digital Markets Act aims to en-

sure the level playing field for gatekeepers and smaller companies (digital startups) by ensuring contestability (reduction of entry barriers) and fairness of digital markets (Brouwer, 2021).

3.4.2. *General overview*

The Digital Markets Act (DMA) is the new European regulation on digital markets, approved by the European Parliament on July 5, 2022, almost two years after the first draft was presented in December 2020. Together with the Digital Services Act (DSA), the two laws together make up the Digital Services Package, which will come into force in 2023.

EU antitrust regulation based on Articles 101 and 102 of the Treaty on the Functioning of the EU (TFEU) – that is often discussed in relation to DMA – acts *ex post*: that is, it sanctions after the anticompetitive violation has already taken place. In contrast, DMA is an *ex ante* regulatory tool aimed to regulate the conduct of large online platforms and counter abuses of market dominance before infringement occurs.

DMA applies to gatekeepers providing core platform services (DMA, Article 1(1)). Article 1(2) of the DMA provides a list of core platform services (CPS) which includes (a) online intermediation services (e.g., App Store, Google Play); (b) online search engines (e.g., Google Search); (c) online social networking services (e.g., Facebook); (d) video-sharing platform services (e.g., YouTube); (e) number-independent interpersonal communications services (e.g., Facebook Messenger, Gmail); (f) operating systems (e.g., iOS, Android); (g) web browsers (e.g., Google Chrome); (h) virtual assistants (e.g., Amazon Alexa); (i) cloud computing services (e.g., Amazon Web Services); (j) online advertising services (e.g., Google Ads). DMA establishes quantitative criteria that qualify an online platform as a gatekeeper:

(1) significant impact on the internal market defined in terms of annual revenues exceeding €7.5 billion in the last 3 years or market capitalisation exceeding €7.5 billion in the last year and providing services in at least three EU member states,
(2) gateway control of business users' access to end users measured as the number of active European users exceeding 10,000 during the last year and the number of monthly active European end users exceeding 45 million, and
(3) a durable and entrenched market position measured as the presence of the previous two criteria simultaneously for at least three years (DMA, Article 3(1)).

If a digital platform is designated as a gatekeeper, it is required to ensure compliance with restrictions and obligations of DMA (Podzun and Bongartz, 2021) which are outlined in Articles 5 and 6 of the DMA. Article 5 contains the "blacklist" of seven "self-executing" obligations that apply to every gatekeeper directly (Petit, 2021). Article 6 specifies additional "grey list" of self-executing obligations that can be subjected to further specifications by means of "regulatory dialogue" between a gatekeeper and the Commission (Podzun and Bongartz, 2021). According to Petit (2021), obligations are derived from past and ongoing competition cases in the EU and can be grouped in four categories based on the type of issues they seek to address (Table 5).

Unlocking consumer choice. Article 5(a) requires gatekeepers to refrain from combining personal data collected from core platform services with other personal data obtained from other services of the gatekeeper or third parties without the user's express consent. The purpose is to limit "surveillance capitalism" practices of consumer profiling and personalised advertising practices (Andrew and Baker, 2019) and reduce data-related economies of scope (Petit, 2021). This requirement relates to the attempt by Facebook to combine personal data from its social network and messaging services that was condemned by the German competition authority in 2019 (De Streel *et al.*, 2021). Article 5(b) prevents gatekeepers from requiring business users to offer their best price conditions on the gatekeeper platform and is related to Amazon e-book, Booking.com and Expedia cases in EU competition law (De Streel *et al.*, 2021). This requirement aims to create better terms for consumers and promote inter-platform competition (Petit, 2021). Article 5(c) allows business users to promote offers and sell their services to the end users outside a gatekeeper's CPS (even if these users were acquired via CPS). The requirement allows business users to rely on multiple different channels for distributing their services online and echoes with the legal investigation of Apple that constrained music application developers to use Apple's purchase mechanisms for paid user subscriptions. Doing so not only allowed Apple to charge commission fees on third-party purchases but also has limited the ability of the applications competing with their own Apple Music service to communicate with end users [3]. Article 5(f) prevents bundling services such as in case of Google that has been fined €4.34 billion in 2018 for imposing restrictions on An-

[3] EC Press Release. 2020. Antitrust: Commission opens investigations into Apple's App Store rules. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1073.

droid device manufacturers and mobile network operators to pre-install Google Search app [4]. In addition, Article 6(1)(b) stipulates that a gatekeeper must allow consumers to uninstall apps pre-installed on their devices as default, following the outcome of the case of Microsoft Explorer browser [5]. Article 6(1)(c) prevents "tying" practices and requires an OS gatekeeper to allow end users to access third party applications by means other than the gatekeeper's CPS (application store or cloud service (Petit, 2021). Finally, Article 6(1)(e) requires gatekeepers to refrain from introducing technical restrictions that prevent end users from switch between different applications on the gatekeeper's operating system.

Promoting data access and mobility. Article 5(e) bans mandating business users to use the gatekeeper's identification service. This requirement limits data extraction possibilities from business and end users. Article 6(1)(h) requires gatekeepers to ensure data portability and enable continuous real-time data access for business and end users. This requirement is expected to allow users to use their data across different platforms. Article 6(1)(i) requires gatekeepers to provide business users with access to data generated through the exchange between business users and their end users on the platform, provided data processing and sharing is compliant with GDPR. Finally, Article 6(1)(j) allows to provide new competitors on the search market access to data generated by end users on its search engines.

Removing discriminatory and unfair practices. Article 6(1)(a) bans gatekeepers from using non-public data generated by business users on their platform to complete with business users. This restriction echoes with the ongoing Amazon Marketplace investigation that allegedly relied on large quantities of data generated from the third party sellers' activity on its marketplace to benefit its own retail business [6]. Likewise, the DMA forbids "self-preferencing": according to Article 6(1)(d), gatekeepers must apply transparent ranking conditions and refrain from placing their own goods and services higher in search results than the third party alternatives. Such practice was found discriminatory in the recent Google Shopping case in 2017 when Google was fined €2.42 billion for design-

[4] EC Press Release. 2018. Antitrust: Commission fines Google €4.34 billion for illegal practices regarding Android mobile devices to strengthen dominance of Google's search engine. https://ec.europa.eu/commission/presscorner/detail/en/IP_18_4581.

[5] EC Press Release. 2013. Antitrust: Commission fines Microsoft for non-compliance with browser choice commitments. https://ec.europa.eu/commission/presscorner/detail/en/IP_13_196.

[6] EC Press Release. 2022. Antitrust: Commission seeks feedback on commitments offered by Amazon concerning marketplace seller data and access to Buy Box and Prime. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4522.

ing an algorithm which pushed down rival comparison shopping services in search results and made their own service more visible to the consumers [7]. Finally, Article 6(1)(f) requires operating system (OS such as iOS or Android) gatekeepers to grant third-party providers of ancillary services (e.g., payments) access to their OS, devices and software on the same conditions as ancillary services of the gatekeepers. This requirement is related to the ongoing antitrust investigation into Apple's terms and conditions for integrating Apply Pay in merchant apps and websites on their mobile devices [8]. As with self-preferencing, the underlying logic is of equal treatment of all services, not only those that are in direct competition (Petit, 2021). Finally, Article 6(1)(k) ensures fair and non-discriminatory access of business users to app stores.

Promoting transparency. Articles 5(g) and 6(1)(g) require gatekeepers that provide advertising services (search engines and social media) to be transparent about pricing and ad performance management, respectively to their business users (Petit, 2021). Article 5(d) stipulates that business users must be allowed (by contractual terms) to file a complaint to public authorities about problematic practices of a gatekeeper.

When a gatekeeper does not comply with the DMA provisions, the Commission can open proceedings and impose fines on the gatekeeper (Podzun and Bongartz, 2021). The DMA provides for penalties of up to 10% of the company's turnover and 20 percent in case of repeat infringement (DMA, Article 30).

[7] EC Press Release. 2017. Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service. https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784.

[8] EC Press Release. 2020. Antitrust: Commission opens investigation into Apple practices regarding Apple Payhttps://ec.europa.eu/commission/presscorner/detail/en/ip_22_4522.

Table 5. – *Summary of obligations stipulated in the DMA based on categories by Petit (2021)*

Type of obligation	Description	Reference to DMA	Examples of past and ongoing competition cases
Unlocking consumer choice	– prevents gatekeepers from combining personal data across different services – prevents gatekeepers from requiring business users to offer their best price conditions on the gatekeeper platform – allows business users to promote offers and sell their services to the end users outside a gatekeeper's platform – prevents gatekeepers from bundling services – allows consumers to uninstall apps pre-installed on their devices – prevents "tying" practices – prevents gatekeepers from technically restricting end users to switch between different applications	Article 5(a) Article 5(b) Article 5(c) Article 5(f) Article 6(1)(b) Article 6(1)(c) Article 6(1)(e)	– Facebook combining personal data from its social network and messaging services (Germany, 2019) – Amazon e-book, Booking.com and Expedia cases in the EU competition law – Apple App Store rules for music application developers (2020) – Google practices regarding Android (2018) – Microsoft non-compliance with browser choice commitments (2013)
Promoting data access and mobility	– bans mandating business users to use the gatekeeper's identification service – requires gatekeepers to ensure data portability and access for business and end users – requires gatekeepers to provide business users with access to data generated through the exchange between business users and their end users on the platform (provided GDPR compliance) – allows new competitors on the search market to access data generated by end users on a gatekeeper's platform	Article 5(e) Article 6(1)(h) Article 6(1)(i) Article 6(1)(j)	Not applicable

Segue

Removing discriminatory and unfair practices	– bans gatekeepers from using non-public data generated by business users on their platform to complete with business users – bans "self-preferencing" – requires operating system (OS such as iOS or Android) gatekeepers to grant third-party providers of ancillary services (e.g., payments) access to their OS, devices and software on the same conditions – ensure fair and non-discriminatory access of business users to app stores	Article 6(1)(a) Article 6(1)(d), Article 6(1)(f) Article 6(1)(k)	– Amazon using marketplace business user data (2022) – Google Shopping case (2017) – Apple practices regarding Apple Pay (2020)
Promoting transparency	– Requires transparency of online advertising service providers (search engines and social media) about pricing to their business users – Requires transparency of online advertising service providers (search engines and social media) about their ads performance management systems – Contractually allows business users to file a complaint about problematic practices of a gatekeeper	Articles 5(g) Article 6(1)(g) Article 5(d)	Not applicable

3.4.3. *Analysis and Critique*

The DMA represents an important regulatory step towards promoting innovation, competition, ensuring fairness and restoring a level playing field for companies in a digital economy. The DMA seeks to offset some of the negative competitive effects of the inherent structural characteristics of the digital economy and aspires to redistribute economic rents along the value chain (Ibáñez Colomo, 2021). Unlike the existing competition laws, DMA does not require the Commission to define a relevant market and establish the fact of market dominance (Cremer *et al.*, 2019, Brouwer, 2021). Coupled with a "fast designation process" (Petit, 2021) using a set of quantitative criteria for identifying gatekeepers, the DMA allows to avoid complex and laborious processes and interfere faster to stop unfair and discriminatory practices.

While acknowledging the advantages of the DMA, academics in the legal field have critically addressed some of the aspects of the DMA. First, while the new regulation applies clear criteria on defining gatekeepers, it is still "leaving room for uncertainty regarding whether the DMA is addressing the right companies" (Podzun and Bongartz, 2021). To that end, DMA applies based on characteristics of a company but regardless of the actual or likely effects of the conduct of a gatekeeper (Petit, 2021).

Second, it is unclear how to distinguish between positive effect of data-driven network externalities for efficiency and welfare gains vs. negative effects of excessive market power and harmful conduct of the dominant gatekeeper firms (Cabral *et al.*, 2021). In this regard, information asymmetries between gatekeepers and regulators need to be reduced so that regulators are better equipped to separate between welfare-increasing and welfare-reducing gatekeeper practices (Cabral *et al.*, 2021).

Third, considering that DMA aims at ensuring "fair" digital markets, the issue lies precisely with the definition of "fairness" used in the DMA. To that end, fairness is defined from a business user perspective in terms of "imbalance of rights and obligations" when "the gatekeeper is obtaining an advantage from business users that is disproportionate to the service provided by the gatekeeper to business users" (Article 10(2) DMA). Moreover, in emphasizing the fairness of results, DMA fails to capture structural fairness problem that stems from the inherent conflict of interest of a platform owner that acts as an agent for both sides of the market (Podzun and Bongartz, 2021). DMA is considered as a "sector-specific" competition law which is primarily concerned with fostering competitive processes and its attention towards fairness remains second-place (Petit, 2021).

Finally, some concerns relate to the implementation and enforcement of

DMA. While "regulatory dialogue" is positively evaluated, analysis reveals the need for closer cooperation between gatekeepers and regulators, requiring setting up a dedicated unit in charge for the dialogue (Podzun and Bongartz, 2021). Enforcement mechanisms can be inhibited if the existing regulatory structures are overly burdened with compliance monitoring resulting in delayed decisions and lengthy investigations (Podzun and Bongartz, 2021) – which was a part of the problem with the existing regulation that the DMA was set to address.

3.5. Data Governance Act (DGA)

3.5.1. *Background*

The European strategy for data [9] published by the European Commission in 2020 has envisioned the creation of a single market for data by creating common European data spaces that will increase data availability for the needs of economy and society (EC, 2020). However, there are several obstacles that have impeded the effective data reuse and sharing so far. First, while data intermediaries have emerged as third-party services that facilitate data sharing by matching data holders with data users, have posed certain risks such as imbalances in market power, structural conflicts of interests (von Ditfurth and Leineman, 2022), lack of transparency and unclear data control mechanisms (Graef and Gellert, 2021) which negatively affected users' trust in their services. Second, there are technical and legal obstacles that prevent the re-use and sharing of public sector data. To date, public sector bodies are mandated to share the data that they hold by the Open Data Directive [10], but this provision does not apply to data types subjected to the rights of third parties such as intellectual property, commercial confidentiality or personal data protection (Baloup *et al.*, 2021). As a result, most companies do not share because they are concerned that the data may be used against them by competitors, and they are afraid to violate GDPR. Finally, while there are certain individuals and businesses that might be willing to share their data voluntarily to benefit society (i.e., for scientific research), there are currently no data sharing mecha-

[9] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A European strategy for data: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0066.

[10] Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information (recast): https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1561563110433&uri=CELEX:32019L1024.

nisms, rules or procedures developed for such cases in the EU (Baloup *et al.*, 2021). To address these issues, the European Commission introduced the Data Governance Act which is designed to facilitate voluntary data sharing across the EU and foster trust in intermediaries.

3.5.2. *General overview*

The Data Governance Act (DGA) as adopted on May 30th, 2022. DGA aims at creating a common European data space that enables data sharing between the private and public organisations across the EU. The main objectives of the DGA are (1) to increase data availability in strategic sectors of economy and (2) to foster trust in the intermediaries that are involved in facilitating the exchange of data.

To achieve these goals, the DGA builds on four main "pillars". First, the DGA creates a legal framework for public sector bodies to share the data they hold that are "protected" based on the third-party rights (e.g., commercial confidentiality, IP protection, personal data). Importantly, the DGA "does not create any obligation to allow the re-use of data held by public sector bodies, nor does it release public sector bodies from their confidentiality obligations" (Article 1, DGA). To that end, the DGA requires public sector bodies to implement safeguards to preserve the protected nature of the data, for instance, by anonymisation of personal data or removing sensitive information from confidential data. Second, the DGA regulates the activity of the emergent type of digital platforms – data intermediation services – that connect holders and users of data (von Ditfurth and Leineman, 2022). By requiring the intermediaries to notify competent national authorities and establishing the conditions for data sharing, the DGA aims to identify trustworthy organisers and foster trust in the newly emergent intermediary industry. To that end, intermediaries will not be allowed to link up their core business with their intermediary services or use the shared data in their own profit-seeking interest. Third, the DGA creates voluntary registration and compliance regime for data altruism services – organisations that voluntary make their data available on a non-profit basis to meet goals of the public interest. Finally, the DGA introduces governance mechanisms on a national and European levels to ensure successful implementation and harmonises conditions for the use of certain public sector data. An overview of the DGA is presented in Table 6.

Table 6. – *Summary of the DGA provisions*

Main themes	Goals	DGA provisions
Re-use of certain categories of protected data held by public sector bodies	• To increase reuse of the public sector data • To establish a legal framework for the reuse of the "protected" public sector data	• Apply to public sector bodies (with exceptions of certain sectors outlined in Article 3.1) • Scope: data protected by third party rights on basis of commercial/statistical confidentiality, intellectual property, or personal data protection (Article 3.2) • Limit exclusive data agreements (exceptions apply for durations no longer than 12 months and for reason that should be made transparent and publicly available) (Article 4) • Require public sector bodies to maintain protected status of the data and ensure that security, integrity and confidentiality standards are preserved (Article 5) • Enforce reasonable fees (Article 6)
Data sharing services regime (intermediation services)	• To increase trust in data intermediaries • To identify trustworthy and neutral data sharing organisations • To improve data sharing through intermediation services	• Define data intermediation services (platforms, databases, data cooperatives) (Article 10) • Requires data intermediaries to notify competent authorities (article 11) • Determines conditions for providing data intermediation services ("purpose minimisation", independency of pricing from the use of other services, service continuity, interoperability) (Article 12)
Data altruism	• To promote data altruism • To create legal mechanisms for voluntary data sharing • To increase transparency	• Requires public registers of recognised data altruism companies (Article 17-19) • Establishes of "rulebook" of technical, informational and security requirements (Article 22) • Imposes transparency requirements / preparation of annual activity reports (Article 20)

Segue

Data governance	• To facilitate data-related cooperation between EU member states • To ensure implementation of the regulation	• Establish competent bodies to provide technical, contractual and informational support to public sector bodies in reuse of protected data sharing (Articles 7-9) • Establish competent authorities for intermediaries' notification procedures, monitoring and supervising compliance (Articles 13-14) • Designate competent authorities for registration and compliance monitoring of data altruism organisations (Articles 23-24) • Establish European data innovation board to advise and assist European Commission in developing consistent practices, guidelines to ensure data protection, security and sector-specific standards (Articles 29-30)

3.5.3. *Analysis and critique*

The DGA is the first legislative instrument that comes into force as a part of the European Data Strategy (von Ditfurth and Leineman, 2022). The DGA's overarching goal is to leverage the potential of available data for economy and society by facilitating reuse of existing data between businesses, individuals, and governments and creating a trusted European ecosystem of data sharing based on European values of privacy, competition and cooperation. According to European Commission (2022), sharing more data will drive data-driven innovation in the strategic sectors of economy such as healthcare (developing cure for rare diseases), agriculture (developing of precision farming and new data-driven services), mobility (efficient transportation system based on real-time data), environmental sustainability (response to climate-induced natural disasters) and public administration (statistics and data-informed actions).

As regards critical assessment of the DGA, some researchers pointed out the risks of inconsistencies with the existing legislations, such as Open Data Directive (Baloup *et al.*, 2021), DMA or GDPR (Graef and Gellert, 2022). Furthermore, issues have been raised with regards to broad definitions and problematic notions in the DGA as well as the feasibility of anonymisation techniques and other safeguards mentioned in the DGA in protecting user privacy and preserving confidentiality of commercial information (Baloup *et al.*, 2021). Finally, while research on the DGA remains limited to date, the scholars have questioned the establishment of "neutral" private data intermediaries as an effective mechanism for voluntary data sharing, especially for individual users. On the one hand, the DGA simultaneously tries to establish data intermediaries as central players in the European data economy while at the same time attempting to pre-empt them from abusing their intermediary position and exploiting their dual role to pursue self-interest at the expense of the other parties of a transaction they mediate (von Ditfurth and Leineman, 2022). On the other hand, in the light of big tech initiatives such as the Data Transfer project [11] developed by Apple, Twitter, Microsoft, Google and Facebook that allows for transferring data across different services, scholars are doubtful as to whether "neutral" intermediaries governed by DGAs will enjoy uptake in market demand (Graef and Gellert, 2022). How exactly the lawmakers plan to stimulate the market demand for intermediary services remains unclear as the DGA appears to assume that the trust in their services alone will drive the demand. Hence, while the DGA is suitable for preventing the abuse of market power, it is not clear whether imposing such regulatory burden and transpar-

[11] https://datatransferproject.dev/.

ency obligations *ex ante* is justified, considering that the data intermediaries currently not only do not enjoy market power but have doubtful prospects of commercial success (von Ditfurth and Leineman, 2022).

3.6. Data Act

3.6.1. *Background*

One of the core problems in the data-driven economy pertains to the manufacturers' exclusive de facto control over data generated by their "smart" connected IoT devices (Kerber, 2022). As a result, data becomes an essential resource which is often concentrated in the hands of a few large manufacturers. This happens due to the bargaining power imbalances between smaller firms and large companies and the absence of clear data portability right for non-personal industrial data for consumers and businesses (Atik, 2022). Furthermore, large vertically integrated players enjoy a data-driven first-mover advantage which creates network effects and barriers to new entry. The problem is exacerbated by the lack of "interoperability" which means that even if smaller firms transfer their data, they are unable to reuse them for new products because of technical incompatibility (Atik, 2022). Consequently, European Commission was urged to present an act which would facilitate non-personal data flow within different sectors in the EU and promote data-driven innovation.

3.6.2. *General overview*

The proposal for an EU Data Act (DA) was officially presented by the European Commission on February 23, 2022. Following the GDPR, DGA, DSA and DMA, the proposed Data Act complements the set of regulations that impact the established data rules. The proposal seeks to establish a cross-sectoral governance framework for machine-generated data access and use, whether by individuals or by European organizations or public authorities. The EU Data Act has the potential to fundamentally reshape the rules governing data-driven business models in the EU.

The main objectives of the DA include ensuring fair allocation of value among different actors in the data economy (DA, 2), enabling consumers and businesses to access and use data generated through IoT devices (DA, 3), facilitate data sharing and availability among consumers, businesses and government (B2C, B2B and B2G) and incentivize innovation and competition by investing in new ways of deriving value from existing and new data (DA, 3).

The DA primarily applies to manufacturers of connected devices and providers of related services that are put on the market in the EU. The proposal clarifies that a "product" also includes movable items which can be embedded in “immovable” item and covers products ranging from connected kitchen appliances to sensor-based industrial machinery, wind turbines and “smart” buildings. The proposal covers both personal and non-personal “raw” data. The proposal also states the existing *sui generis* right under the Database Directive 96/9/EC that protects databases that “have been created as a result of a substantial investment “in obtaining, verifying and presenting the data” does not apply to databases “containing data generated or obtained by the use of products or related services”, i.e., as a by-product of another activity (Article 35, DA).

Table 7. – *Rights and obligations of manufacturers of connected devices and providers of related services according to DA proposal*

Main areas	Main objective	Rights and obligations in accordance with DA proposal
Data access and sharing for B2C and B2B	• To increase legal certainty for businesses and consumers regarding who can use and access the data they generate and under which conditions • To provide access to data for users of products and services in IoT products and virtual assistants • To preserve incentives for manufacturers to invest in new ways to generate high-quality data	• Manufacturers/service providers must ensure that their connected products and service are designed as default to provide users (consumers and businesses) with access to data (Article 3.1) • Transparency obligations to inform users in advance about data generated, its intended use by manufacturers and their access rights (Article 3.2) • Right to access and use data by users (Article 4) • User right to share data with third parties under certain conditions (Article 5 and 6) • These obligations do not apply to micro and small enterprises • Data access should be provided on fair, reasonable and non-discriminatory contractual terms (Article 8.1) and at cost to SMEs (Article 9)
Prevention of abuse of contractual imbalances	• To ensure fair distribution of data-driven value between enterprises • To prevent SMEs from being unilaterally imposed unfair contractual conditions that impedes them to make business based on data	• Contractual terms considered as unfair and unilaterally imposed are not binding in contracts with micro- and SMEs (Article 13.1) • The proposal provides a list of unfair terms (Article 13.3 and 13.4) • The European Commission will develop model contractual terms in order to help draft market participants and negotiate fair data-sharing contracts (Article 34)
B2G data sharing	• To facilitate the use of business data by the public sector	• Public sector may request data from the private sector in case of public emergency when the da-

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	in exceptional cases (e.g., public emergency) • To clarify rights, obligations and mutually beneficial terms of use of business data by the public sector	ta cannot be obtained by other means and lack of data prevents acting in the public interest (Article 14 through 17) • Data must be provided free of charge (Article 20) • Micro and small enterprises are exempted from obligation to make data available to a public sector (Article 14.2)
Data portability, interoperability, and standard setting	• To facilitate switching between data processing services (including cloud) for consumers • To create a competitive market for cloud services in Europe • To increase the variety of choice for cloud users	• Users are granted a right to switch providers • Providers must enable "effective switching" by eliminating "commercial, technical, contractual and organisational" barriers (Article 23) • Gradual abolishment of switching charges (Article 25) • Requirements of interoperability (Articles 28-30) to facilitate data sharing mechanisms from technical standpoint

The DA proposal addresses four main themes (Table 7): (1) data access and sharing for B2B and B2C, (2) prevention of abuse of contractual imbalances, (3) business-to-government (B2G) data sharing and (4) data portability, interoperability and standard setting. First, the DA proposal obliges product manufacturers and related service providers of medium size and above to make the data generated by their products' use easily accessible to the user (business or consumer). The latter can then use and transfer the data to third parties under certain limitations. For instance, data cannot be shared with gatekeepers (Article 6.2(e)) or used for developing a competing product (Article 6.2(f)). The intent is to promote innovation and the creation of complementary data-driven business models. Second, SMEs will gain protection against fair contract terms imposed by a company that enjoys much stronger market position. Third, the DA will establish clear rights and obligations for the use by the public sector of data held by private companies in the case of public emergencies and provided transparency, proportionality, purposeful use and respect for mutual interest. Finally, the proposal seeks to ensure well-functioning and competitive cloud infrastructure, eliminating lock-in effect with the established cloud providers and envisions "a seamless multi-vendor cloud environment" by enabling open specifications and European standards for interoperability (DA, p. 16).

The DA proposal introduces penalties for infringement of up to 4% of global annual turnover or €20 million (whichever is higher).

3.6.3. *Analysis and critique*

The DA proposal is a recent important initiative in supporting business-to-business sharing of machine generating data and legally protecting the interests of the smaller players on the digital market. Currently, the DA remains a proposal and the draft is likely to be subject to change. Yet, several lines of criticism have emerged as a reaction to the proposal. First, the proposal was criticized for trying to pursue incoherent goals simultaneously. To that end, while the new rights to access data is rather extensive, they are still limited by the clause that prevents using the data for competing with the product/service which generated that data (Picht, 2022). Furthermore, if the goal of the DA is to encourage data re-use and processing, then it might conflict with the existing data legislations such as GDPR that advocates the principle of data minimisation (for personal data) (Perarnaud and Fanni, 2022). Second, the DA's provisions on interoperability apply to cloud and other data processing services providers but do not provide any information on which type of technical interoperability is desirable for ensuring seamless data sharing (Colangelo, 2022, Kerber, 2022). Third, key definitions and the scope of the provisions are rather high-level and leave room for different interpretation ("data", "data holder"). However, this might be an intentional choice signalling the possibility of future sector-specific regulations in the data domain (Atik, 2022).

If the DA is implemented, it will present both opportunities and threats for companies' business models. On the one hand, companies that offer maintenance or complementary services – and rely on machine-generated data from the products – will have the opportunity to provide better services. On the other hand, the DA constitutes a threat for companies that digitalised their products hoping to build their new business model based exclusive data access and unimpeded data monetisation. Building a competitive advantage on monopolising access to data and capturing full value from data will no longer be an option. Hence, the new business models will need to be able to succeed even in case other companies can access and use the same data to benefit customers in innovative ways.

3.7. Artificial Intelligence Act (AI Act or AIA)

3.7.1. *Background*

In February 2020, European Commission publishes a White paper on AI – A European approach to excellence and trust which lays down policy options aiming at encouraging business to develop "trustworthy" AI that creates benefits for

the society, is aligned with EU fundamental values and human rights and "the opacity, complexity, bias, a certain degree of unpredictability and partially autonomous behaviour of certain AI systems" (European Commission, 2021). The White paper outlined the benefits of AI for citizens (improved healthcare, safer transport, etc.), business (new generation of products in machinery, transport, cybersecurity, farming, etc.) and public interest (efficient transport, education, energy and waste management, sustainable products, law enforcement, citizens' safety). While acknowledging the need to promote AI within the EU, the White paper also emphasises that for AI to be "trustworthy", it should ensure human oversight, privacy, safety, fairness, transparency, accountability and overall contribute to societal and environmental wellbeing. Together with Ethics Guidelines for Trustworthy AI (HLEGAI, 2019) and Policy and Investment Recommendations for Trustworthy AI (HLEGAI, 2019), these documents have laid down the principles and risk-based approach which became the foundation of the Artificial Intelligence Act (AIA) which was first published as a legislative proposal in on April 21st, 2021 (Floridi, 2021).

3.7.2. *General overview*

AIA is a horizontal regulation proposal that legislation that applies across all industry sectors and technology applications (AI Act, 2021). AIA introduces risk-based approach to AI. To that end, the proposed regulation divides AI systems in three categories: unacceptable, high- and low-risk AI:

– Unacceptable risk AI includes "subliminal, manipulative or exploitative techniques which can cause harm", social scoring and "real-time" biometric identification in public sector (except for special cases of law enforcement). Unacceptable risk systems will be banned on the EU territory (Article 5).
– High risk AI includes systems used to assess customer creditworthiness, recruiting systems, biometric identification in non-public spaces, AI-based administration of justice and systems that will put human life in danger in case of failure. Systems classified as "high risks AI" will be subject to additional scrutiny and will be mandated to take extra measures to ensure fair process, including (Article 8-15):
  • Compliance with requirements;
  • Risk management system;
  • Data training and data governance;
  • Technical documentation;
  • Record keeping;

• Transparency and provision of information for users;
• Human oversight;
• Accuracy, robustness and cybersecurity.

– Low or minimal risk AI include AI-based chatbots, computer games, inventory management, market segmentation systems. Low risk AI is subject to fewer requirements which involve transparency about using AI, such as informing users upfront that they will be interacting with a machine or openly disclosing if a content was manipulated by AI (i.e., "deep fakes").

In case AI does not fall into these categories but uses EU personal data, it will fall under GDPR but not under prospective AI regulation.

The law stipulates administrative fines for non-compliance and infringement which range from up to €10 million of 2% of the global annual turnover (whichever is higher) to €30 million or 6% of global annual turnover (whichever is higher) (Floridi, 2021).

3.7.3. *Analysis and Critique*

AIA represents a bold attempt to develop a normative framework that promotes "ethically sound, legally acceptable, socially equitable and environmentally sustainable" AI in the EU (Floridi, 2021) and has several important advantages. First, AIA is conceived of as a regulation (not a directive) would mean that when it enters in force, it will have a binding regulatory force throughout all 27 member states (Floridi, 2021). Second, similar to GDPR, AIA might enable extending compliance with AIA even beyond the EU. This is known as Brussels effect (Bradford, 2020) which means that companies outside the EU de facto will adopt the same standard even when doing business with countries outside the EU where AIA will not apply. This is expected to happen for two reasons. First, it will be easier for companies that do business in the EU to maintain the unique high standard globally. Second, it will be hard to explain to the public why the company allows to use lower standards in other countries (Floridi, 2021) that expose its customers to risks of unethical AI-based outcomes. Third, AIA is based on the ethical principles designed by HLEG which prioritise protecting fundamental human rights. However, unlike principle-based self-regulatory mechanisms, AIA introduced legal punitive mechanisms for non-compliance, clearly outlines the rights of the natural and legal persons, gives them a possibility to invoke these rights in national courts of law (Mittelstadt, 2019). The mandatory nature and the risk-based approach of the regulation increase corporate accountability and reduce risks for the citizens and the society overall. Fourth, the proposed legislation emphasises that AI is a technology that can assist in environmental protection,

waste reduction, mitigation of climate change and sustainability (Cowls *et al.*, 2021). Finally, the proposal does not consider futuristic science-fiction scenarios in which AI is endowed with an agency of its own. The proposed legislation takes a scientific approach to AI and acknowledges human responsibility for designing, implementing and using for decision-making (Floridi, 2021).

AIA proposal also has several noteworthy limitations. The first limitation of the proposed regulation is its unclear terminology and scope (Smuha, 2021a, Wischmeyer and Rademacher, 2020). AIA relies on the following definition of AI: "artificial intelligence system" (AI system) means software that is developed with one or more of the techniques and approaches listed in Annex I and can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with." Annex 1 references machine learning, logic-, knowledge-based and statistical approaches. The definition provided is poorly fit for legal purpose as it too vague and can potentially include any type of software (Glauner, 2022). There is no uniform definition of AI because AI is an umbrella term used for different techniques and applications (Smuha, 2021a). Furthermore, "intelligent" technologies are not stable as they tend to "lose their intelligence status" over time, once they become mainstream and more advanced technologies start to appear (Smuha, 2021a). Two solutions are proposed by Hacker (2020): (1) to replace AI term with machine learning (ML) as the latter has a concrete definition which states that ML algorithm improves its performance at given tasks as it learns from experience of performing these tasks, or (2) introducing regulation for software that exhibits risks associated with AI/ML, not AI/ML per se.

Second, although the risk-based approach in the proposed AIA is consistent with an idea that the intensity of regulation needs to be proportionate to the degree of intensity of potential harm (Krafft and Zweig, 2020), the proposed risk classes (unacceptable, high, low) are too few and too abstract for regulation which leaves room for loopholes and legal uncertainty (Hacker, 2020). Such vague categorisations can result in prohibiting even innocuous AI systems. Furthermore, in case of high-risk AI applications, the proposal appears to mix "two senses" together that need to be conceptually distinguished (Floridi, 2021). On the one hand, there are AI systems that are well-intended but present high risk if they do not function properly (e.g., self-driving cars). On the other hand, there are AI systems that are high risk if they are put to unethical use and precisely because they function well (e.g., real-time biometric surveillance of citizens). Therefore, the ambiguity about the nature of "high" risk may inhibit the feasibility of some measures and assessments proposed by the AIA (Floridi, 2021).

The third issue with the proposed regulation lies with the "harm requirement" as it appears that "manipulative AI systems appear permitted insofar as they are unlikely to cause an individual (not a collective) 'harm' (Veale and Borgesius, 2021, p. 99). First, harm is difficult to prove as it often arises as a result of cumulative effect over time rather than a single event and, therefore, can be used as opportunity to circumvent the law. Second, the proposal is primarily concerned with individual and – to a lesser extent – to collective harm but appears to overlook the harm which can ensue for those that are not directly subjected to AI systems and extend to society overall (Smuha, 2021b).

Fourth, the proposed AI regulation can hinder innovation and give unfair advantage to companies developing AI outside of the EU (Glauner, 2022). Moreover, imposing strict requirements on AI development can minimise the risks associated with this particular technology but would not prevent the same risk from materialising by means of a different technology, and "might merely push AI deployers towards the use of other tools to achieve the same problematic end" (Smuha, 2021a, p. 64). Furthermore, the new law may merely drive the development of some "unacceptable" or "high-risk" AI applications to other countries with more lenient regulatory regime (Floridi, 2021) or exporting them to countries with more authoritarian rule (Veale and Borgesius, 2021). An example of the latter includes Noldus (Netherlands) selling facial analytics tool or Idemia/Morpho (France) selling facial recognition software to Chinese public authorities (Amnesty International, 2020).

Finally, the scope of the envisaged reporting documentation is too large and often not feasible. Concerns have been raised whether transparency should be considered as a primary solution to solve problems of algorithmic unfairness and discrimination in the context of AI-based algorithmic systems because of their legal, technical and commercial limitations for transparency. First, secrecy (as opposed to transparency) is default in the private sector. This implies that most of the proprietary algorithms enjoy intellectual property and trade secrets protection and are exempted from the disclosure requirements (Hansen and Flyverbom, 2015). Second, AI-based algorithms are inherently complex and opaque "black-boxes" which makes their full disclosure technically unfeasible (Kroll *et al.*, 2017). Third, there is an informational asymmetry between the actors and the forum as the latter lacks necessary competence and expertise to understand the internal workings of an algorithm (Kemper and Kolkman, 2019). Simplifying an algorithm to make it interpretable, on the other hand, compromises its technical sophistication and predictive performance, negatively affecting innovation potential and competitive advantage of the firms subject to AI regulation (Kearns and Roth, 2019). Fourth, disclos-

ing an algorithm may open the possibilities for individuals to "game the system" and exploit disclosed information to their personal gain if it becomes accessible to unauthorised individuals (Ananny and Crawford, 2018). Finally, even if these hurdles are overcome, the question remains as to whether transparency is what individual users actually need. While disclosing and explaining how an algorithm arrives at a particular decision can be desirable, in many instances users would have preferred a discriminatory, unfair or privacy-violating algorithmic outcome not to happen in the first place rather than receiving an ex post explanation of how the outcome has been generated (Edwards and Veale, 2017). Finally, it is not clear whether disclosing more information about an algorithm to individual users is actually effective for holding the companies to an account. Doing so places excessive burden on individuals to collect, process and interpret information without simultaneously empowering them to hold a company accountable for misconduct and impose consequences (Smuha *et al.*, 2021).

3.8. Concluding remarks

Rapid technology development and expected increase in connectivity supported by 5G network infrastructure will result in generating massive amounts of personal and non-personal data in the EU in the future. Data is regarded as an asset which is a prerequisite for establishing strong European data economy. However, the existing regulations were gradually losing their relevance and adequacy in the new digital realities. In this regard, over the past decade the European Commission has introduced six important regulatory initiatives aimed at creating safe, fair and trustworthy digital environment (Table 8).

Table 8. – *Overview of data-related regulations in the EU*

Legislative instrument	**Status**	**Applies to**	**The scope**	**Sanctions for non-compliance**	**Applies from**
GDPR	In force	• Companies that process personal data of EU citizens as their "core activity"	• fully or partly automated processing of *personal* data	up to €20 million or 4% of a company's annual global turnover (whichever is higher)	From May 25th, 2018

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DMA	In force	• Core platform services designated as "gatekeepers"	• Anti-competitive, discriminatory and unfair practices • Transparency requirements • Data mobility and interoperability	up to 10% of a company's turnover and 20 percent in case of repeat infringement	From May 2nd, 2023
DSA	In force	• Online intermediaries (e.g., social networks, online platforms, marketplaces)	• Transparency and accountability • Content moderation • Automated advertising	up to 6% of total annual turnover	From February 17th, 2024
DGA	In force	• Public sector bodies • Data intermediation services • Data altruism organisations	• Re-use of "protected" data held by public sector bodies (protected based on commercial or statistical confidentiality, IP protection, personal data protection) • Voluntary data sharing	Sanctions to be introduced by national regulators	From September 24th, 2023
Data Act	Proposal	• Manufacturers of IoT products • Data processing services • Cloud service providers	• Requirements for machine-generated data sharing for B2C and B2B • Cloud switching • Data portability	up to 4% of global annual turnover or €20 million (whichever is higher)	Not applicable

Segue

AI Act	Proposal	• Providers of AI systems placed in the EU • Users of AI systems	• Risk-based approach • Prohibited AI practices • Requirements for high-risk AI system providers • Transparency obligations	range from up to €10 million or 2% of the global annual turnover (whichever is higher) to €30 million or 6% of global annual turnover (whichever is higher)	Not applicable

On the one hand, new regulatory initiatives aim at protecting the rights and freedoms of the European citizens. The GDPR establishes rights of individuals regarding their personal data and seek to empower users is using, accessing and transferring their data while at the same time reinforcing accountability of companies that process that data. The Digital Service Act aims to tackle the issue on harmful online activities (e.g., "fake news", "hate speech") and outlines responsibilities and obligations of online platforms and marketplaces regarding content moderation, disinformation and illegal content or activity. The proposed AI Act addresses the long-standing issue of algorithmic bias and discrimination and calls for increased transparency of algorithmic decision-making. In essence, these regulations seek to create a safe digital environment for the European citizens that would uphold the human rights, privacy and freedom.

On the other hand, new legislation aims at restoring competition, fostering innovation and addressing the structural market failures inherent in the digital economy because of high economies of scale, high entry barriers and network effects. To that end, the Data Market Act aims to ensure effective competition in digital markets by preventing discriminatory and unfair practices of large online "gatekeeper" platforms that control and exclusively access large amounts of data and abuse their quasi-monopolistic market position vis-à-vis smaller companies. The proposed Data Act should establish new rights on machine-generated data to ensure fair distribution of value along the data value chain and making more data available for market participants to innovate their services and to compete with larger manufacturers "on an equal footing". The Data Governance Act aims at harmonising conditions for the reuse of certain data in the public sector and promotes the voluntary sharing of data between individuals, businesses and public sector by creating trustworthy and neutral data intermediaries.

In sum, such regulatory approach demonstrates that the European Commission is making important inroads to promote European data economy by creating conditions for the companies to be able to access a main strategic asset: data.

4.
Assessing the value of big data and analytics: issues, opportunities and challenges

4.1. Introduction

Big Data (BD) is a hot topic that garners great interest from both scholars and practitioners due to its potential to support and affect accounting practices (Gartner and Hiebl, 2018; Quattrone, 2016; Warren *et al.*, 2015), but there is little empirical evidence of BDA's impact and value (Rikhardsson and Yigitbasioglu, 2018). Most of the scientific contributions published so far have focused on the potential implications of BD in the field of business management. Because of the limited evidence of BDA's impact, especially on accounting practices, the related research field is still considered to be in its infancy (Arnaboldi *et al.*, 2017). As emphasised in the previous chapters, there is a growing body of research on BD use in auditing and business (e.g., Brown-Liburd *et al.*, 2015; Vasarhelyi *et al.*, 2015) and its effects on the future of the accounting profession (e.g., Tysiac and Drew, 2018; Richins *et al.*, 2017). The overall conclusion of this literature is that the future lies in emerging technologies and all forms of automation. On the one hand, some studies (e.g., Wamba *et al.*, 2015) reveal that a majority of companies have not begun to capitalise on BD because they appear to still be in the learning stage. On the other hand, some large accounting firms and corporations are investing heavily in both technological tools and people with technical knowledge (Schmidt *et al.*, 2020). There is currently no common trend towards these investments because there is no clear understanding about the real effects brought and consequent value created by BDA (Vitale *et al.*, 2020). Nevertheless, there is as yet limited understanding of how organisations realise social and economic value from the BDA (Günther *et al.*, 2017; Vidgen *et al.*, 2017).

Specifically, there are still many doubts about the types of technological investments and analytical skills required to use Big Data Analytics (BDA) to

extract BD value (De Santis and Presti, 2018). BDA are advanced techniques and technologies that are often also called business analytics, real-time analytics, predictive analytics or business intelligence (Chen *et al.*, 2012). They detect new patterns and correlations from huge amounts of data (John Walker, 2014). In turn, such detection permits insights that help managers act and react more precisely, making better predictions. Therefore, BDA implementation allows for more informed decisions and more accurate conclusions (McAfee *et al.*, 2012). This is possible thanks to the first described step, in which BDA allows for the extraction of essential insights from BD (Gandomi and Haider, 2015). For this reason, BDA is considered beneficial and essential for the improvement of corporate decision-making processes and performance. BDA has a fundamental role in supporting BD use and application: improvements in technology are revolutionising the way in which unstructured data are collected, transmitted, stored and analysed. Conversely, as emphasised in the previous chapters, BD and BDA present many challenges and give rise to many doubts. First, the volume and variety of the gathered data (two fundamental Vs characteristics of BD; Saggi and Jain, 2018) often prevent their high quality and the possibility to use them promptly for decision-making purposes, requiring a difficult and time-consuming data filtering operation based on human capacity and expertise. Becoming data-driven is not merely a technical issue – it requires the development of a business analytics ecosystem in which people and organisations are able to develop capabilities and business strategies to deal with the analytical challenges in a systemic and joined-up way (Vidgen *et al.*, 2017). Moreover, as abundantly highlighted in previous chapters, BD ubiquity implies privacy concerns and problems related to its control, access and use (La Torre *et al.*, 2019). For this and many other reasons, data has no value in and of itself. BD becomes valuable when it is collected properly, analysed correctly and applied to pertinent decisions (Müller and Jensen, 2017). When this happens, the extant literature emphasises that BD helps decision makers, favours the development of competitive advantage and may improve corporate performance. These conditions are extremely significant because the number one issue for businesses that have invested in BDA is determining exactly how to get value from BD (Van Der Meulen, 2016).

Developing competitive advantage and capturing value from BD-BDA through their integration and transformation are the main purposes of the entire corporate process based on BD acceptance, assimilation and routinisation (Tseng *et al.*, 2016). From this point of view, the concept of BD value is extremely broad. Indeed, BD (through the implementation of BDA) may bring "significant economic and social benefits to both individuals and companies" (Le Roux, 2012). While, as described in the previous chapters, the strand of

research relating to BD challenges, risks and opportunities is still in a growth phase, the definition of BD corporate value has yet to be fully realised. Specifically, there are still many doubts and debates about data valuation and monetisation (Grover *et al.*, 2018). Data valuation is the assessment of a precise data value (actual accounting, economic, financial or strategic value); data monetisation is the process of turning BD-BDA investments into cash or an asset form that is easily convertible into cash. Therefore, the extant literature suggests that BD-BDA may represent a valuable asset, but the attribution of a monetary value to BD is difficult due to the features (i.e., Saggi and Jain, 2018; the Vs, in Zikopoulos at al., 2012) of such data, which are reusable, can be integrated, are never actually consumed and show increasing and differentiated returns depending on the intensity and methods of integration. Academic research and practice underline the importance of understanding the value of this asset, which derives from the possibility of generating insights (rather than from inherent conditions) and the actual use of the same (Clemons *et al.*, 2017; Ferraris *et al.*, 2019; Grover *et al.*, 2018; ISACA, 2014). The assessment of such value is the main objective of this chapter, considering different definitions, characterizations and methods.

4.2. Data as a valuable commodity

The importance of creating a digital ecosystem and the advent of BDA have led to a sort of data-based economy in which data has become a valuable commodity to be used in transactions (Dumay, 2009; McFarland *et al.*, 2015; La Torre *et al.*, 2018). BDA implementation allows for the analysis and interpretation of various types of BD. As mentioned before, BD is produced in high volume and variety, resulting in both structured and unstructured data collected from internal and external organisations of financial and non-financial natures (Appelbaum *et al.*, 2017; Nielsen, 2018). Moreover, BD is often generated and collected according to an inductive approach, either without a pre-defined objective or for reasons other than those that are actually pursued (Constantiou and Kallinikos, 2015; Newell and Marabelli, 2015). All of these possibilities explain the relevance of BDA implementation. There are several definitions of analytics (Vidgen *et al.*, 2017), but the core of all definitions is the creation of insights from data through the scientific and technical processes of transformation (Davenport and Harris, 2007; Informs, 2016). Therefore, BDA is especially useful with unstructured data, engendering the revelation of unexpected BD combinations and patterns of analysis (Aaltonen and Tempini, 2014). Indeed, it is by and large assumed that the share of struc-

tured data among all existing data is only 5%, and the rest is unstructured (Gandomi and Haider, 2015). If this data, unstructured for the most part, is considered a valuable commodity in the current data-based economy, it should possess certain qualities that enable its value to be appreciated.

Indeed, high-quality data (since data generation or because of its transformation) represents an important business resource (Chae and Olson, 2013) and can impact corporate performance (Forslund and Jonsson, 2007; Gorla *et al.*, 2010). High-quality data is complete, precise, valid, accurate, relevant, consistent and timely (Appelbaum *et al.*, 2017; Redman, 2013). High-quality data may amplify its value, showing the ability to provide future-oriented analysis and support corporate projections. Old legacy systems and the method of data acquisition are factors influencing BD quality that can, in turn, be positively influenced by a clear business analytics strategy in which the issue is logically and systematically examined and tackled as a business transformation initiative and is not considered only an IT departmental issue (Vidgen *et al.*, 2017).

Traditionally, the preparation of financial statements has been based on historical values, but the current business world requires more timely information (Nielsen, 2015). For this reason, corporate decision-making struggles when based on historical financial statements' information, which in turn are based on past events and backward-looking data; more forward-looking data is needed for running a business (Oesterreich and Teuteberg, 2019). In times of rapidly growing data volumes, it is considered insufficient to rely purely on historical data for guiding decisions; rather, companies should make use of future-oriented business analytics to identify and understand market trends and customer behaviours (Bhimani and Willcocks, 2014). Corporate decision-making processes require information from both internal and external data, clarifying doubts about prior events, making predictions and considering consequences for uncertainty and risk in decisions. Indeed, the rise in BD could help this process, as both structured and unstructured data from both inside and outside the company can be included in analyses providing forecasts and market trends, supporting accurate decisions and adding value (Brands and Holtzblatt, 2015).

Therefore, high-quality, timely and future-oriented BD driving decision-making processes may exert a positive impact on firm performance (Brynjolfsson *et al.*, 2011; Brynjolfsson and McElheran, 2016). Firms using BD and BDA for decision-making show higher outputs and productivity (Oesterreich and Teuteberg, 2019). It is crucial that accountants provide support and adjust their responsibilities to help companies gain a competitive advantage through a new corporate decision-making process based on accurate data, permitting the adoption of a temporal perspective in evolution (Nielsen *et al.*, 2014). Indeed, BD and BDA represent a pervasive phenomenon that

could affect management accounting, financial accounting, financial reporting practices (Warren *et al.*, 2015) and auditing (Brown-Liburd *et al.*, 2015; Yoon *et al.*, 2015). Data and information are at the heart of what accountants do and therefore the accounting and auditing professions can engage with BD-BDA in many different ways (ICAEW, 2015).

In summary, BD has an exchange value when it is recognised as a commodity to be traded. Together, BD and BDA may be considered highly valuable assets of an organisation (Chugh and Grandhi, 2013). This requires that the organisation controls such set of resources that, in turn, can provide value and a competitive advantage for the organisation. Indeed, when the appropriate analytical tools, expanded data sources and appropriate systems are in place, BD can be analysed to reveal data patterns and meaningful information, systematically supporting the decision-making process and impacting organisational performance.

4.3. Information valued more than data

BD is continuously created by smart devices, radio-frequency identification technologies, sensors, social media, available video surveillance and more (Elkmash *et al.*, 2021). "Everywhere we go, everything we say, everything we buy leaves a digital trace that is recorded and stored" (Vidgen *et al.*, 2017, p.1). Specifically, much of today's BD comes from social media and is consequently unstructured. An important contributor to BD's massive scale and scope arises from the growing ubiquity of social media as an arena in which corporations and individuals interact (Bellucci and Manetti, 2017; Van den Bussche and Dambrin, 2021). Social media applications were not intended to become corporate tools (Brivot *et al.*, 2017), but today, most organisations exploit them to determine how they can use such sources and the retrieved data to create (and protect) value (Manyika *et al.*, 2011; Yui, 2012).

BD is typically described considering data characteristics called Vs (Zikopoulos *et al.*, 2012), which in turn can be distinguished as essential characteristics, such as volume, velocity and variety (i.e., based on large volumes of extensively varied data that are generated, captured and processed at high velocity; in Laney, 2001), and organisational characteristics, such as veracity, visualization, viscosity and virality. However, BD by itself has little value; BD value is realised only when it is possible to effectively leverage data with a mix of critical thinking and technology. In other words, BD in combination with BDA can answer many important questions. Thus, the real value of BD-BDA is not in the size and complexity of the data but rather in the quality of

how BD is used to create valuable information (achieving the overall V of value), which involves analysing the right data with the right analytical tool (Dow *et al.*, 2021). It represents a complex process that primarily depends on a firm's ability to manage multiple resources (including the data itself as the "raw" input of the process) and involves the many capabilities of both people and organisation in a proactive and synergic way related to both technology and organisation to obtain valuable information. The key actions to be implemented in such a process regard the development of BD-BDA business strategies that should be based on some key items: BD quality, BDA implementation for improved decision making, and the dissemination of analytical capabilities throughout the organisation (Vidgen *et al.*, 2017).

Therefore, data represents a sort of "raw" input in such complex processes and needs BDA to be stored, processed and analysed to provide meaningful information and support the decision-making process (Elkmash *et al.*, 2021). BD's value lies in an organisation's ability to transform enormous volumes and types of data into knowledge that is useful for business decisions (Fehrenbacher *et al.*, 2022; La Torre *et al.*, 2018; Secundo *et al.*, 2017). Organisations are required to analyse structured and unstructured data in a meaningful manner to obtain deeper insights into customer-related behaviour, their service usage and real-time interests (Ciampi *et al.*, 2021; Ghasemaghaei and Calic, 2020) to enhance business performance, competitive advantage and innovation (Munir *et al.*, 2022). BDA can lead to patterns and insights that had not been considered *ex-ante* when BD was generated and/or collected (Madsen, 2015). Indeed, invaluable insights and competitive advantages may be gathered through BD analysis implemented with the right technological and organisational resources (Morabito, 2015). Therefore, BDA applications can be a valuable resource for companies to gain a competitive advantage (Abbasi at al., 2016; Agarwal and Dhar, 2014; Côrte-Real *et al.*, 2014; LaValle *et al.*, 2011). Competitive advantage provides that a firm has greater success than its current or potential competitors (Peteraf and Barney, 2003). It includes both qualitative (i.e., strategic) and quantitative (i.e., financial) dimensions of performance (Ringle *et al.*, 2012). La Torre *et al.* (2018) point out that the aim of any BD analysis is to enhance organisational decision-making and the capability to transform data into knowledge and then actions. Therefore, the production of new and useful information unveils BD-BDA value, creating knowledge and supporting decisions (Ibrahim *et al.*, 2021). The role of BDA in gaining insights and valuable information from data does not replace human judgement – on the contrary, BDA facilitates and supports human actions. BDA interconnectivity is based on the interplay between human and algorithmic intelligence to retrieve BD from heterogeneous sources, gather their con-

nections through sophisticated technologies and extract valuable insights (Günther *et al.*, 2017). Scholars have paid great attention to the automation of decision-making processes (Loebbecke and Picot, 2015; Markus, 2015) and the analysis of situations lacking human intervention (Lycett, 2013; Yoo, 2015). In these cases, data and algorithms gain a sort of supremacy, shaping human actions and decisions. This happens when BDA implements real-time decisions and actions based on users' clicking behaviour, and such BDA actions, in turn, influence users' behaviour (Newell and Marabelli, 2015). This example of an operational cycle in a BDA application explains the disempowerment of the human capacity for judgement. There is a need to cultivate and strengthen human intelligence (Ekbia *et al.*, 2015) and the human capacity to examine data and patterns (Seddon *et al.*, 2017; Sharma *et al.*, 2014). Human intelligence is supported by human expertise able to solve problems even in unknown (environmental) conditions (Kshetri, 2014), common sense and contextual knowledge (Shollo and Galliers, 2015). Excessive reliance on BDA may imply both the depletion of human intelligence and a poor decision-making process, progressively losing the methods and patterns followed by BDA to gather results and make decisions (Markus, 2015; Newell and Marabelli, 2015). Therefore, to gain insights from BD, human intelligence should be supported (not replaced) by BDA, which explicitly needs a human in its proceedings (Jagadish *et al.*, 2014). In turn, this point is related to the need for proper education and skills by decision-makers with organisational power. If value is derived from insights and information obtained from the data through the implementation of appropriate algorithms, then BDA implementation must be promoted accurately, insights must be interpreted correctly, and consequent decisions must be made by capable people in power, having strategic objectives in mind. This process requires the involvement of different business stakeholders (including business analysts), whose interaction and combined skills are fundamental for value realisation from BD-BDA (Günther *et al.*, 2017).

Moreover, businesses and organisations used to store and analyse their data using relational databases and data warehouses designed to deal with structured data (Elkmash *et al.*, 2021). At first, they were used only for marketing purposes (Israel, 2009), but they have since become essential for communicating with stakeholders and trying to enforce their positive perceptions of the business (Harquail, 2011). From this point of view, BDA value (for companies) becomes associated with the business' capacity to control corporate reputation and bridge the gap between how the company wishes to be seen and how stakeholders actually perceive it (Fombrun, 1996). The control of corporate reputation is quite difficult because it is unstable and constantly recreated (Barnett and Pollock, 2012; Carroll, 2013). It is related not only to

regulation and legislation (about privacy, identity theft, illegal discrimination and unjust classification, as described in the previous chapters) but also to public expectations and ethical considerations concerning the process of realizing value from BDA (Newell and Marabelli, 2015). In any case, corporate reputation and the effort to control it have significant value for companies. "On average, more than 25% of a company's market value is directly attributable to its reputation [...]. In fact, if the executives who participated in our study on reputation risk are right, a company's reputation should be managed like a priceless asset and protected as if it's a matter of life and death, because from a business and career perspective, that's exactly what it is" (Deloitte, 2014, p. 2). Organisations may consider their efforts to develop BDA privacy and ethics policies (about data retention, security and disposal) an opportunity to differentiate themselves from competitors (Greenaway *et al.*, 2015). This reputational impact further highlights BDA's value as a source of competition and strategic positioning (Greenaway *et al.*, 2015; Jagadish *et al.*, 2014; Van den Broek and Van Veenstra, 2018). Organisations try to control data access through ownership and rights that can be based on formal contracting and selling. Therefore, organisations often state a precise selling price (monetary or in exchange for other products) for either raw data or information obtained through BDA implementation (Günther *et al.*, 2017; Woerner and Wixom, 2015). Firms may also choose to share information only with network partners; in this way, BDA value is related to corporate benefits for having access to such networks and obtaining (in exchange for free) other data (Van den Broek and Van Veenstra, 2018). BDA networking emphasises that organisations can gain value from BDA portability, favouring its flexibility in transferring and adapting to different contexts and for different purposes (Günther *et al.*, 2017; Woerner and Wixom, 2015). BDA networking and knowledge sharing are considered tactically and strategically important for companies, providing opportunities to increase value (Lorenzoni and Lipparini, 1999; Saraf *et al.*, 2007). Therefore, synergies with business partners can be beneficial (Setia *et al.*, 2015), but careful attention must be paid to information sharing agreements, as firms are reluctant to share sensitive information that might compromise their competitive advantage (Côrte-Real *et al.*, 2017).

4.4. Information as intangibles to be valued in financial statements

A relative shift from physical to intangible means of production has been taking place in the last several decades (Haskel and Westlake, 2018). Scholars voiced critiques regarding the lack of adequate accounting for these ever more

important intangibles (Lev, 2003). The measurement of intangibles presents several difficulties and challenges, such as the same conceptualization of intangibles, the valid construction of objective measures, the restrictive and different treatments envisaged by different regulations and accounting standards (Van Criekingen *et al.*, 2021). However, the relevance of intangible resources has increased rapidly. The annual study by Ocean Tomo LLC (2022) shows that intangible resources are already responsible for 90% of the SandP500 market value as of the year 2020.

BD, BDA and human intelligence are intangible resources. In general terms, the perceived value of any item, also an intangible resource, is a function of the net benefits of that item (Kahneman and Tversky, 1979). This requires consideration of two sub-values:

– the perceived switching benefits related to "the perceived utility a user would enjoy in switching from the status quo to the new configuration" (Kim and Kankanhalli, 2009, p. 573);
– and the perceived switching costs related to "the perceived disutility a user would incur in switching to the new configuration" (Kim and Kankanhalli, 2009, p. 572).

BD collection and BDA adoption may imply organisations' benefits across many domains, such as e-commerce, e-government, science, health, and security (Chen *et al.*, 2012). These benefits can transform into (real) value on the basis of the organisation's economic expectations and strategic goals for adopting and implementing BDA (Ghoshal *et al.*, 2014). Data-driven companies have been examined to be, on average, 5% more productive and 6% more profitable than their competitors (McAfee *et al.*, 2012), but, as emphasised in the previous chapter, becoming a data-driven organisation is a complex process with plenty of risks and challenges: do the benefits of becoming such an organisation outweigh the correlated costs? The answer to this question is strictly related to the abovementioned data valuation and data monetization. Indeed, value may be defined as the monetary worth of the benefits a customer receives from a product or service, compared to the price paid and the cost of ownership and taking into account competitors' offerings. More value implies the increase of competitive advantage (Lindgreen *et al.*, 2012). There are high costs required from both BD and BDA (Pape, 2016): BD implies costs to generate, storage, clean and maintain data items; BDA implies costs to extract information from BD. Moreover, BDA technologies call for substantial investment in implementation and maintenance that may also discourage firms understanding BDA potential value and benefits (Côrte-Real *et al.*, 2017). Indeed, BDA can increase a cost structure's complexity (Bhimani and Willcocks

2014). "Pathways to value" from BD may be particularly long and costly also because of the application of the abovementioned inductive approach requiring trolling through large amounts of unstructured data. On the one hand, this may be either an expensive and sometimes unfruitful effort, especially when lacking a precise business purpose or a process maximizing the likelihood of value realization (Gao *et al.*, 2015). Therefore, the benefits obtained from the insights gained by inductively approaching BD need to compensate for such time-consuming efforts and costs (Tamm *et al.*, 2013). On the other hand, the incremental cost of repeating analytic procedures is low, allowing a more frequent application of the same analytic procedures in order to manage and monitor better organisational processes (Appelbaum *et al.*, 2017). In turn, the progressive decrease of computation and storage costs facilitates continuous monitoring (Alles and Gray, 2006) and procedures improvement over time (Van der Vlist, 2016). Considered both BD-BDA benefits and costs, the resulting net benefits could (or not) transform into value according to organisational objectives (Günther *et al.*, 2017). On the one hand, most literature emphasises BDA net benefits for organisations in general terms from improved decision-making process (Constantiou and Kallinikos, 2015; Sharma *et al.*, 2014) and operations concerning customer relationships, services and products, employers' selection, supply chain flows (Chen *et al.*, 2012; McAfee *et al.*, 2012). On the other hand, few pieces of literature focus on the economic and social value that can be gained from such benefits based on BDA implementation (Galliers *et al.*, 2015; Günther *et al.*, 2017).

As discussed in the previous section, BD, representing a commodity with an exchange value to be traded, has also a potential intrinsic value that needs to be gathered through BDA implementation and human intelligence in order to become a source of knowledge. This process enables both the generation of information and its flow, adding primary value to the initial "raw" data (Chau and Xu, 2012; Popovič *et al.*, 2012). BDA implementation through proper human intelligence is the driver to convert BD into information and knowledge, providing more transparent and accurate results, supporting decision-making process and adding business value (Côrte-Real *et al.*, 2017). Thanks to such driver, gathered information represents a worthy intangible asset, characterized by immateriality (i.e., absence of physical substance) and economic benefits granted to its owner. The definition of intangible asset is provided by International Accounting Standard (IAS) 38: "*An identifiable non-monetary asset without physical substance. An asset is a resource that is controlled by the enterprise as a result of past events and from which future economic benefits are expected to flow to the entity*". Furthermore, American accounting principles (i.e., US GAAP) provide strict rule for intangibles' recognition stat-

ing that internally-generated intangibles cannot be capitalized. The recognition of intangible assets has been a much-discussed problem in accounting, and this is not only a problem of the digital age (Aboody and Lev, 1998; Leitner-Hanetseder and Lehner, 2022).

Intangibles are playing a crucial role in the current data-driven economy as knowledge assets represent one of the main types of intangible resources together with customer orientation and synergy (Bharadwaj, 2000). While tangible assets are becoming less and less valuable in the global economy, the worth of the intangible "asset" of information and the ability to turn information into value has grown (Lukomnik, 2018; Schmidt *et al.*, 2020). Indeed, the strict criteria for intangibles' recognition are evident already in the same definition provided by IAS 38, especially in the entity's need to control the immaterial resource and certain expectation of future economic benefits. For all the reasons described above and in the previous chapters, these two criteria are particularly difficult to be assessed for BDA information and knowledge, which are intangible resources. Some recent literature highlights the limits of the current financial reporting model and the drawbacks of the relative accounting standards, assessing that they cannot be considered sufficient to recognise the value of BD-BDA important drivers (Lev, 2019): accounting standards and periodic reporting appear as anachronistic and unable to keep pace with the multitude of data available to the market (Pei and Vasarhelyi, 2020).

Given the current importance of intangibles for business competitive advantage, the strict treatment of intangibles in accounting rules, often preventing the same identification of such assets, may lead financial reports to heavily underestimate the true value of companies and discourage the growth in intangibles investments (Lev, 2018; Lev and Gu, 2016; Van Criekingen *et al.*, 2021; Zadorozhnyi and Yasyshena, 2019). The same accounting literature offers a wide range of identification and measurement approaches representing opportunities to enhance intangibles' understanding and update accounting standards (Guthrie *et al.*, 2012; Osinski *et al.*, 2017; Petty and Guthrie, 2000; Sveiby, 1997).

Summarizing, BD represents both a commodity with an exchange value recognised in BD trading and a "raw" input of a process aimed at generating information, knowledge and (consequently) value. The combination of BD, BDA and human judgement may generate an intangible asset when the enterprise can identify and control data through BDA and human intelligence, as a result of past events, also expecting the flow of provable future economic benefits.

4.5. Concluding remarks

The extant literature concerning BD-BDA value appears as characterized by a limited number of empirical studies and some repackaging of consolidated ideas (Günther *et al.*, 2017). Much emphasis regards organisational "paths to value" starting from BD-BDA and considering several supporting factors, such as the interaction between tools, tasks, and people. There emerges the need for further empirical studies that carefully examine how organisations actually realise value from BDA in practice, building on process thinking (Langley, 2007) for studying the realization of BD value through interdisciplinary research, and potentially, mixed methods (Mingers, 2001). Literature about the relationship among knowledge management and firm performance is still limited (Liu *et al.*, 2014). Moreover, the most of such limited literature does not relate to accounting and does not examine BD-BDA value from an accounting point of view. For this reason, some critical literature suggests that financial reporting and assurance have not been able to keep up with the pace of evolution of its underlying components (Pei and Vasarhelyi, 2020). Furthermore, current accounting rules create a bias with greater understatement of the earnings and assets of companies with growth in intangibles investments and overstatement for companies with declining investment (Van Criekingen *et al.*, 2021). There are two main critical issues about BD-BDA. First, many firms do not know how to capture business value from BD collection and BDA implementation (Barton, 2012; LaValle *et al.*, 2011). Some scholars (Côrte-Real *et al.*, 2014; Malladi, 2013) argue that BDA value research needs to extend beyond post-adoption stages toward competitiveness (Erevelles *et al.*, 2016; Xu *et al.*, 2016). Preparing and implementing an effective BDA strategy, firms may undertake BDA value creation process through its different stages from knowledge creation to competitive performance (Côrte-Real *et al.*, 2017). Second, accounting should account for BD-BDA value, distinguishing the exchange value of "raw" data from the worth of information intangible asset. As discussed above, this (i.e., the worth of information intangible asset) is the result of a valuable knowledge generation process controlled by the enterprise on the basis of past events and implemented by the enterprise for the expected future economic benefits.

Conclusion

Big data (BD hereafter) and business analytics (BDA hereafter) influence nearly every area of major companies' decision-making, strategic analysis, and forecasting (Appelbaum *et al.*, 2017; Griffin and Wright, 2015). In order to gain or keep a competitive edge, a company may produce, acquire, extract, gather, filter, and analyse massive amounts of data from both internal and external sources. Indeed, BD is ubiquitous and BDA represents a priority for every company that wants to stay competitive: they are no more just the purview of a small number of early innovators and implementers (Davenport, 2006). The potential of BD and BDA to change both the nature and practice of both accounting and auditing has been demonstrated in prior work (Alles and Gray, 2016; Appelbaum *et al.*, 2017). Starting from these premises, this book aimed at answering three important questions asking (1) whether accounting scholars can explain the emergent issues with BDA using established accounting theories, (2) whether and, if so, how the processing of BD results in calls for wider organisational accountability and greater regulatory oversight and (3) how the value of BDA can be assessed from a financial accounting standpoint. Therefore, it focuses on three main topics related to BD and BDA in accounting, i.e. theories, regulations and value recognition.

First, there isn't a precise (or at least convergent) theoretical foundation for the analysis of BD and BDA (Mikalef *et al.*, 2019). The theoretical evolution of the technology should be the subject to further discussion and investigation, as the research to date has tended to be more concerned with its practical applications (Secinaro, 2020). BDA requires a reevaluation of the nature and classification of reality, research methodology, potential paradigms, and the process of knowledge construction. Accounting is evolving as a result of this enormous epistemological shift and most likely will continue to change (boyd and Crawford, 2012; Leitner-Hanetseder *et al.*, 2021; Napier, 2006). The BD epistemological revolution needs to be further investigated because the majority of BDA research employ a data-driven technique that is utterly at odds with the scientific epistemological perspectives that have long been supported

in accounting and auditing (La Torre *et al.*, 2018; McAbee *et al.*, 2017). The revolution in epistemology has prompted the belief that data can support and frame theory (Cong and Du, 2022). At least in fields other than accounting, this is nothing new. In the paradigm known as grounded theory, many research contend that data can generate theory (Glaser and Strauss, 1967). Through data that has been gathered and examined, this theory seeks to identify and debate the key problems that arise "from the field" (Walsh *et al.*, 2015). The literature analysis, which is presented in the second chapter, emphasizes that studies based on grounded theories put an emphasis on the data, first analysing the data and then describing the data themselves. The interpretative approach tries to gather data in order to obtain a number of important theoretical components that support the presence and nature of the BDA revolutionary phenomena (Senik *et al.*, 2013). In contrast, the focus of all the other explored theoretical perspectives is on man and organization (knowledge, ability to govern available resources, and exercise of power). This consideration has two significant ramifications. First, the second chapter seeks to identify a point of convergence within the significant degree of theoretical fragmentation that characterizes the sample of papers reviewed and more generally BDA studies in accounting. Indeed, the majority of the examined research either lack a theoretical framework or use one that is distinctive and peculiar. Second, recognising the relevance of data as a result of the BD-BDA revolution, there emerges the need to develop and identify as irreplaceable human skills and judgment in order to fully obtain the value of BDA, as highlighted also in the fourth chapter.

Second, as regards the regulation in the digital economy, European Commission is taking the lead in adapting the regulatory frameworks to address the important issues related to BD and address the ineffectiveness pertinent to self-regulatory approach. The new regulatory initiatives – enforced and proposed – broadly fall into two major categories: regulations aiming (1) to protect individual rights and freedoms of the EU citizens (GDPR, DSA and AI Act) and (2) promote fair competition and innovation in the digital economy and limit the power of the large technology companies' vis-a-vis their customers, rivals, and suppliers (DMA, DGA and DA).

As regards the former category, the GDPR is the first "reform" of the personal data protection that seeks to harmonise European laws on data processing. The GDPR establishes new rights for individuals whose data is being processed in order enable them to regain control of their personal information. Furthermore, the regulation introduces new obligations for companies who handle the personal data and outline a list of principles that companies should

adhere to. Differently from the preceding Data Protection Directive 95/46/EC, the GDPR explicitly recognises the importance of accountability for the companies that handle personal data and requires them to go beyond mere legal compliance towards taking a proactive stance on personal data protection (Andrew and Baker, 2021). For organisations, the GDPR has implied fundamentally revising their internal data-related operational processes and the design of their products or services with the view of customer and employee privacy in mind as default. The GDPR also creates additional reporting requirements on organisations with regards to data security breaches (Andrew, Baker *et al.*, 2021). The Digital Services Act (DSA) aims to create a safe and trustworthy digital environment and to ensure that the fundamental rights of users are protected online. Differently from GDPR, the DSA regulates primarily online intermediaries and platforms (e.g., social media networks, content-sharing platforms) and addresses problems with illegal content and harmful conduct that has led to dissemination of misinformation, hate crimes, user behavioural profiling and implicit algorithmic manipulation (Zuboff, 2015). The DSA adopts a "layered" approach and impose stricter obligations and greater transparency requirements on more powerful companies that are more likely to engage in harmful conduct. The proposed Artificial Intelligence Act (AI Act) is a first AI-related legal framework that seeks to address the problem of fairness and discrimination in algorithmic decision-making. The AI Act is still a proposal that still has not been approved and is subject to multiple amendments. The provisions of the proposed AI Act apply to providers of AI systems and differ based on the magnitude of risk that an AI system is considered to have. If the AI Act retains the risk-based approach when adopted, it will prohibit certain "unacceptable" AI systems on the EU territory (such as subliminal behavioural manipulation, social scoring, or real-time biometrical identification system) and impose "light" obligations of "low-risk" AI. The focus of the proposal is on the high-risk AI (e.g., AI-based recruitment, credit assessment systems) that will be subject to a series of risk and conformity assessments, dataset validation, data quality and transparency requirements.

As regards the latter category, the Digital Market Act (DMA) regulates the activity of so-called gatekeepers that have a disproportionate power on the online platform market and take advantage of their "bottleneck" position and exclusive access to platform data in order to limit competition and raise barriers for market entry for new companies. The DMA seeks to establish fair conditions for all players in the digital economy, lower switching costs for consumers and foster innovations among technology startups and SMEs. In a similar vein, the proposed Data Act (DA) aims to achieve fair distribution of value generated by data, increase accessibility and stimulate sharing of the ma-

chine-generated industrial data among the market participants. To that end, the DA seek to protect the interests of companies in a less advantageous bargaining position vis-à-vis their more powerful counterparts and create opportunities for new business model innovations based on data. Finally, the Data Governance Act (DGA) establishes a legal framework for voluntary data sharing between businesses and public bodies. The legislations are aligned with the European Strategy for data which envisions the creation of a single data market based on collaboration, sharing and non-rival access to data and harnessing the potential of data for the economy, society and environmental sustainability and respecting the fundamental rights and freedoms of the European citizens. To that end, the European Union has been at the forefront of data-related regulation which might become a global standard even beyond its borders. Indeed, new regulatory landscape in the EU data economy aims at mitigating many of the economic, business, social, environmental, ethical and reputational risks that have been extensively discussed in the management science, accounting research and business ethics scholarship (Corbett, 2018; Flyverbom *et al.*, 2019; Martin, 2019; West, 2019). There are several *theoretical implications* that one can envision with a relative degree of certainty. First, the EU creates a regulatory environment which aims at protecting fundamental human rights when it comes to data collection and processing. Therefore, theories and frameworks that were built on the premise that the problems of technology-driven violation of human rights proliferate in the absence of proper regulation will need to be revisited taking into consideration the new realities. In a similar vein, theoretical research rooted in the idea of unconstrained power of the large technology platforms that are unaccountable to anyone but themselves may gradually decrease in relevance as the EU regulations represent the first steps in making the "Big Tech" more transparent and accountable, protect users against illegal practices online and create fair competitive conditions for smaller enterprises. Second, the new regulations are likely to create streams of research whose implications will be constrained to a particular geography as the magnitude of the technology-related risks will be different for countries where some of the new EU regulations do not apply. Third, introducing data-related regulations may solve some problems while ignoring other issues and creating new risks, similar to the privacy vs. surveillance tension in the GDPR discussed by Andrew and Baker (2021). Theoretically exploring unintended consequences and regulatory trade-offs will necessitate combining the knowledge from law, business management, ethics and accounting and will require interdisciplinary theorizing. Moreover, there emerge also *practical implications* of the new data regulations representing a "double-edge"

sword as they entail positive changes for some stakeholders while signifying negative trends for the others. First, while new regulations aim to create fair competitive conditions and present new opportunities for smaller enterprises by enabling new business models based on data access and sharing – something of which smaller companies along the data value chain were previously deprived of (Martin *et al.*, 2019). At the same time, the regulations inevitably limit the use of business models based on creating unique competitive advantage through securing exclusive data access and monetisation. As a result, companies will be required to find innovative and creative business opportunities that are based on data and yet ensure legal compliance. This implies revisiting existing business models and operational data processes as well as carefully planning future data analytics initiatives, in particular based on advanced artificial intelligence and machine learning algorithms. Second, the new regulations constrain the possibilities for revenue generation through user data collection and processing and prevent the larger companies from "locking-in" their users to their platform (de Matos and Adjerid, 2022). Similarly, new regulations require companies to revisit their approach to processing employee personal data and analysing personal information for internal efficiency, control and monitoring purposes (Brassart Olsen, 2020; Plester *et al*., 2022). Third, new regulations impose more severe transparency requirements about data security breaches (Andrew *et al*., 2021), personal data processing activities (Andrew and Baker, 2021), logic of algorithmic systems (Heldt, 2022) and their risks (Smuha, 2021), content moderation and disclosure of complaint handling (Husovec and Roche, 2022), pricing mechanisms and performance management in online advertising (Petit, 2021), the intended use of machine-generated data (Kerber, 2022). To sum up, companies will be required to develop stronger regulatory competences inside the organisations to ensure compliance and transparency vis-à-vis other stakeholders as well as to align their managerial decision making with the new legal requirements.

Finally, the majority of the existing research on BD-BDA value focuses on organizational "paths to value" beginning with BD-BDA and taking into account other supporting elements, such as the interplay between resources, activities, and individuals. The concept of value itself appears to be central to the economic debate, but it is subject to different possibilities of definition and theorization (Corvo and Pastore, 2019). Moreover, literature on the connection between knowledge management and business performance is still scant (Liu *et al.*, 2014) and the majority of this literature is unrelated to accounting, not analysing the usefulness of BD-BDA from an accounting perspective. Conse-

quently, some studies critically conclude that financial reporting and assurance have not kept pace with the change of its fundamental components (Pei and Vasarhelyi, 2020). Additionally, the existing accounting standards, not yet updated to take full account of BD-BDA value, may create a bias that may result in a higher understatement of earnings and assets for companies with growing investments in intangibles and an overstatement for companies with declining investments in intangibles (Van Criekingen *et al.*, 2021). The fourth chapter of the book highlights two major issues regarding BD-BDA value. First, many organizations do not know how to derive value from BD collection and BDA development (Barton, 2012; LaValle *et al.*, 2011). Some scholars (Côrte-Real Real *et al.*, 2014; Malladi, 2013) contend that the study of BDA value must go beyond post-adoption phases (Erevelles *et al.*, 2016; Xu *et al.*, 2016). Businesses can create value through BDA across various stages, from knowledge generation to competitive performance (Côrte-Real *et al.*, 2017), by planning and implementing an effective BDA strategy. Second, accounting must consider BD-BDA value, differentiating the exchange value of "raw" data from the value of information that may represent an intangible asset. Indeed, this (i.e., the value of information) is the outcome of a valuable knowledge generating process that the company controlled based on previous occurrences and conducted for the predicted future economic benefits.

In this way, the present work underlines the necessity for additional BDA research, contending that evaluations of the real impact of BDA investments and use are needed in order to comprehend how to accomplish the benefits. The recency of both the literature emphasis on BDA value and the described new regulations (and the provisional status of the legislative acts that have not been adopted yet) explain the limited scope of published academic research, lack of empirical data and practitioners' analysis on the topic. For these reasons, at the point when the manuscript is written, one can only hypothesize about the possible effects of the new regulations with no possibility to test these effects empirically. Moreover, the present manuscript presents an overview and historical developments of the new data regulations but leaves out of scope the existing regulations that are still in effect and can affect the data-related activities of the companies. Getting a more "holistic" picture of the older and new regulations and providing an insight from a legal and business perspective as to how they are mutually interconnected is one of the possible areas for improvement. Finally, while the literature has been examined without geographical distinctions, the analysis has been focused solely on the regulatory initiatives of the EU. While the EU is the "frontrunner" of the data-related regulations, similar regulatory initiatives in other countries that have been left out of scope of this manuscript, equally deserve scholarly attention

and should not be overlooked. Again, this offers new opportunities for accounting research. First, the EU has pioneered a set of legislative acts that have no precedent in the international practice. At this point, no comparative historical data exists in other countries to use as a benchmark to assess the effect of the new regulations on the emergence and adaptation of companies' business models, financial performance and managerial decision-making. Therefore, future studies could be based on empirical data analysis of the companies subjected to the EU regulation prior and following the enforcement of the new laws. Second, since the regulations emphasize the pursuit of goals of "sustainable" data economy, understanding the effect of the new regulations on the sustainability of the business practices and managerial decision-making oriented towards long-term value creation presents a promising area of research. Third, considering that the new regulations demand more transparency from organisations, future research can explore the extent to which legally mandated transparency is effective as a means of achieving greater corporate accountability in data-related activities. Finally, a fruitful opportunity is to explore the issues that the new regulations do not currently cover, examine their unintended consequences, analyse opportunities and formulate suggestions for further regulatory improvements.

References

Introduction

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Chapter 3: Data regulations in the European Union

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Chapter 4: Assessing the value of big data and analytics: issues, opportunities and challenges

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