

# Corporate accountability and big data analytics: is non-financial disclosure a missing link?

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## Abstract

**Purpose** – This paper aims to identify, synthesise and critically examine the extant academic research on the relation between big data analytics (BDA), corporate accountability and non-financial disclosure (NFD) across several disciplines.

**Design/methodology/approach** – This paper uses a structured literature review methodology and applies “insight-critique-transformative redefinition” framework to interpret the findings, develop critique and formulate future research directions.

**Findings** – This paper identifies and critically examines 12 research themes across four macro categories. The insights presented in this paper indicate that the nature of the relationship between BDA and accountability depends on whether an organisation considers BDA as a value creation instrument or as a revenue generation source. This paper discusses how NFD can effectively increase corporate accountability for ethical, social and environmental consequences of BDA.

**Practical implications** – This paper presents the results of a structured literature review exploring the state-of-the-art of academic research on the relation between BDA, NFD and corporate accountability. This paper uses a systematic approach, to provide an exhaustive analysis of the phenomenon with rigorous and reproducible research criteria. This paper also presents a series of actionable insights of how corporate accountability for the use of big data and algorithmic decision-making can be enhanced.

**Social implications** – This paper discusses how NFD can reduce negative social and environmental impact stemming from the corporate use of BDA.

**Originality/value** – To the best of the authors' knowledge, this paper is the first one to provide a comprehensive synthesis of academic literature, identify research gaps and outline a prospective research agenda on the implications of big data technologies for NFD and corporate accountability along social, environmental and ethical dimensions.

**Keywords** Big data, Analytics, Accountability, Non-financial disclosure, Structured literature review

**Paper type** Literature review

## 1. Introduction

Over the past decade, much academic research and considerable practitioners' literature have been focused on the possibilities that big data analytics [1] (BDA) opens up for sustainability and long-term societal value creation (Gupta *et al.*, 2019; Seele, 2016, 2017; Zhu



and Li, 2021), corporate environmental performance (Chen *et al.*, 2015; Dubey *et al.*, 2019; Singh and El-Kassar, 2019) and more democratic forms of stakeholder governance (Neu *et al.*, 2019; Saxton and Neu, 2021).

While acknowledging the social and environmental benefits of BDA, a number of scholars have also provided critical accounts of why the initial optimism regarding the role of BDA in driving positive change was largely unwarranted (Flyverbom *et al.*, 2019) and have brought scholarly attention to a wide range of ethical (Andrew *et al.*, 2021; Andrew and Baker, 2021; Martin, 2019), legal (Ferguson, 2019) and environmental (Corbett, 2018) issues associated with BDA. Thus, the adherents of the critical approach from multiple disciplines have called for a better understanding of the effective mechanisms for holding businesses accountable for the risks emanating from BDA.

One such important mechanism for enhancing corporate accountability is non-financial disclosure (NFD). This refers to both voluntary and mandatory corporate disclosure that is provided on environmental, social, governance and sustainability matters, as well as on other possible key corporate issues, as recently highlighted also by the measures taken by the European Union (EU Commission, 2014, 2021).

In this paper, we are interested in understanding how BDA affects the effectiveness of NFD in terms of enhancing corporate accountability. Specifically, we address three research questions:

- RQ1. What do we currently know about the relationship between big data analytics, corporate accountability and non-financial disclosure?
- RQ2. Does academic research currently address the environmental, social and ethical consequences of big data analytics?
- RQ3. What recommendations can we formulate to promote positive change?

We contribute by identifying, integrating and critically examining extant academic research on the relation between BDA, accountability and NFD across several disciplines. Academic interest in BDA in the accounting field has grown substantially over the past few years, evidenced by a number of recent special issues dedicated to the topic in leading journals (Arnaboldi *et al.*, 2017; Flyverbom *et al.*, 2019; Haenlein *et al.*, 2022). Yet, no comprehensive review of the literature on BDA implications for corporate sustainability, ethics and accountability has been performed until now. Though this does not constitute a research gap *per se*, such a review is important to realise how scholarly debate on the emergent topic of BDA has evolved in the context of societal value creation, to understand the state of theory development and to provide empirical justification for the proposed research directions (Dumay *et al.*, 2016).

Our analysis includes three major steps. First, we carry out a structured literature review (SLR) to identify relevant studies (Massaro *et al.*, 2016). Second, we classify the identified contributions by allocating them to four conceptual categories (Secundo *et al.*, 2017). Finally, to critically examine the studies in each category, we apply an “insight-critique-transformative redefinition” framework (Alvesson and Deetz, 2000; de Villiers and Sharma, 2020).

The remainder of the paper is organised as follows. Section 2 describes the methodological steps of a SLR and presents the coding framework. Section 3 classifies our review of the research work into four categories. Section 4 interprets and critically examines the literature and outlines a prospective research agenda. Section 5 discusses limitations and provides concluding reflections on the role of BD in enhancing corporate accountability through NFD.

## 2. Methodology

We used a SLR approach (Dumay *et al.*, 2016; Massaro *et al.*, 2016). To ensure the objectivity and reliability of our review, we closely followed the six steps for developing an SLR outlined by Massaro *et al.* (2015):

- (1) define the research questions;
- (2) develop and write a research protocol;
- (3) conduct a literature search;
- (4) develop a coding framework;
- (5) code articles and ensure reliability, and
- (6) critically analyse and discuss the results.

Given that the research questions have been outlined earlier, we proceed with the discussion of the following steps.

## 3. Research protocol

As per SLR methodology, we started by developing the literature review protocol, which is schematically represented in Figure 1. The protocol delineates the scope, describes the screening criteria and outlines the review process.

### 3.1 Literature search and selection

As our primary data source, we used the Scopus abstract and citation database which contains over 26,000 peer-reviewed journals from more than 7,000 international publishers as of July 2022 [2]. The five subject areas chosen for our review were as follows:

- (1) business, management and accounting;
- (2) decision sciences;
- (3) social sciences;
- (4) environmental sciences; and
- (5) computer sciences.

Such subject area selection ensured a sufficient breadth of search without compromising the relevance of the search results.

To obtain a comprehensive cross-disciplinary literature sample, the literature search on Scopus was organised in two stages. In the first stage, we performed a keyword search across all journals within the five subject areas. The search terms included “big data”, “accountability”, “value creation”, “non-financial”, “integrated reporting”, “corporate social responsibility”, “CSR”, “sustainability” and “disclosure” (and any derivatives of the last two terms). The search conditions were specified in a way that the results returned only those studies that contained the “big data” term *and* any of the other subsequent terms in the article’s title, keywords or abstract. We have considered papers that were published in peer-reviewed journals up until 2021 inclusive.

In the second stage, we narrowed down the scope of the search to a set of leading accounting and business ethics journals [3] and used “big data” as a single search term. Doing so permitted us to have a complete overview of the current state of research on BD in the field of accounting and business ethics and to identify additional papers that were overlooked in the first stage because of the more stringent search terms. After combining the two data sets and excluding 35 duplicates, we obtained an initial set of 1,942 articles.

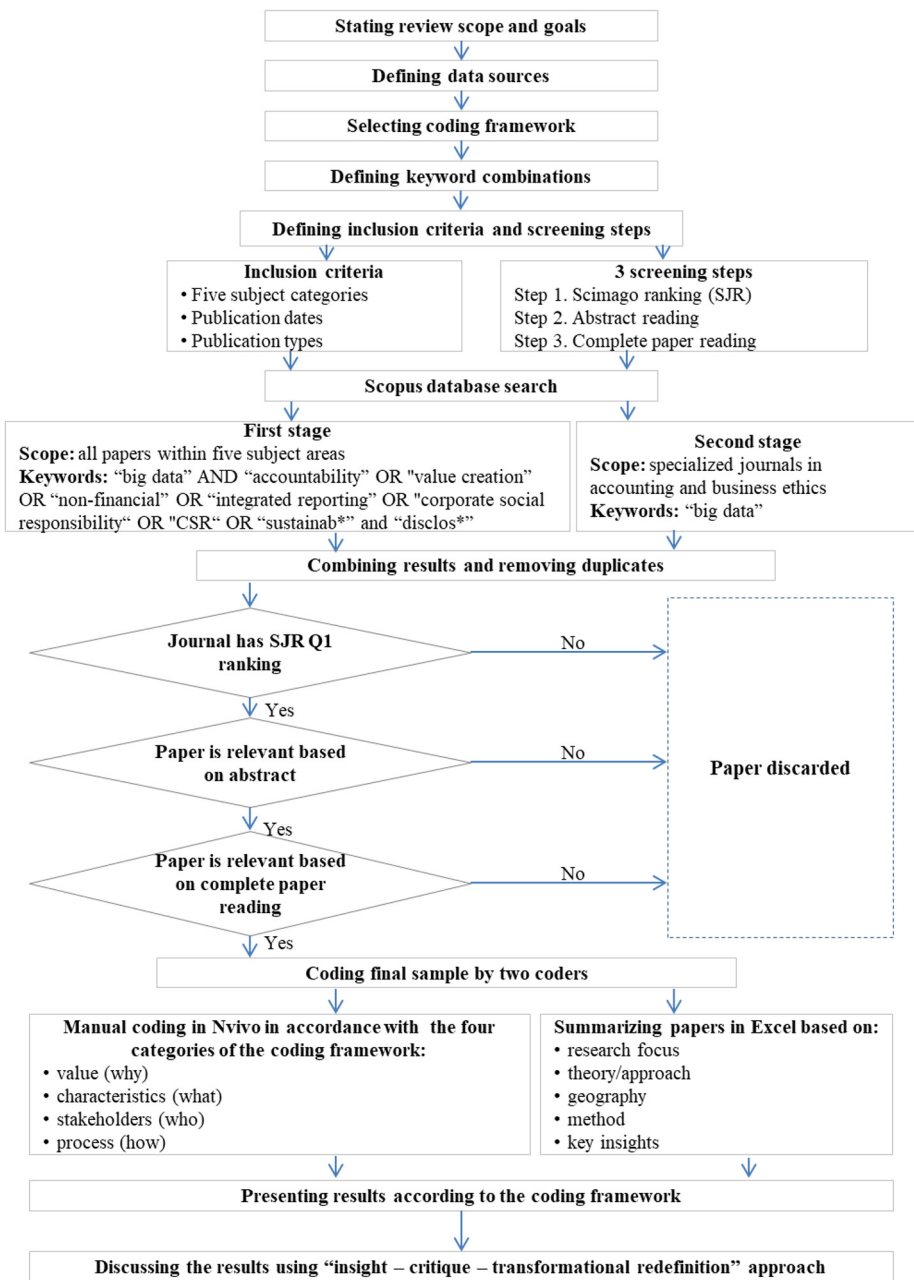


Figure 1.  
Literature review  
protocol

Next, we proceeded to identify relevant articles by following a three-step screening process (Table 1). First, to narrow down the review to high-quality journal outlets in each of the five subject areas, we applied Scimago Journal Ranking and retained only those journals that belonged to the first quartile within each respective subject area (Massaro *et al.*, 2016). Applying this criterion shortened the list of papers to 603.

Second, we distinguished between relevant and non-relevant papers by screening the abstracts. On the basis of the abstract analysis, we retained 147 papers as relevant. The abstract analysis was carried out by two coders independently and then compared; disagreements were treated on a case-by-case basis. A paper was excluded from the review as irrelevant if its topic was not pertinent to our research questions.

Third, after reading the complete papers, we discarded 34 papers as irrelevant. As a result, the final sample for the review was composed of 113 articles.

### 3.2 Coding framework

We adopted a four-category coding framework that was originally developed by Secundo *et al.* (2017) to explore BD in the context of intellectual capital. The framework is particularly suitable for our purpose of conducting a multi-disciplinary SLR because it allows the capturing and logical structuring of the multitude of ways in which BDA can affect business and society. The four categories are described as follows:

The first category (“why”) is concerned with the *value* of BDA and includes articles that examine the benefits of BD with regard to enhancing corporate performance along environmental and social dimensions, as well as managerial motivations behind the use of BDA. The second category (“what”) includes papers exploring the socio-technical *characteristics* of BDA and their transformational effect on organisations, the environment and society. The third category (“who”) includes papers that discuss various types of *stakeholders* that either affect or are affected by BDA. More specifically, papers that explored the change in the nature of relationships between stakeholders or discussed BDA implications for corporate accountability *vis-à-vis* certain stakeholder groups were assigned to this category. The fourth category (“how”) relates to the *process* of data collection, storing, processing, analysing and reporting. Papers were assigned to this category if they explored the emerging social, ethical and environmental implications of the use of BDA along the data value chain or if they discussed issues related to algorithmic transparency and accountability.

Data sources	Initial search results*	Step 1. Screening based on SJR ranking		Intermediate sample 1	Step 2. Screening based on abstract		Intermediate sample 2	Step 3. Screening based on complete paper		Final sample
		(%)			(%)			(%)		
Scopus five subject areas	1,924	-1,339	-70	585	-451	-77	134	-32	-24	102
Scopus specialized journals	18	0	0	18	-5	-28	13	-2	-15	11
<b>TOTAL</b>	<b>1,942</b>	<b>-1,339</b>	<b>-69</b>	<b>603</b>	<b>-456</b>	<b>-76</b>	<b>147</b>	<b>-34</b>	<b>-23</b>	<b>113</b>

**Note:** \*Excluding 35 duplicates

**Table 1.**  
Literature screening process

### 3.3 Coding procedure and reliability

The coding procedure was organised as follows. First, all relevant papers were preliminarily coded based on their abstracts. Next, each paper was read in full, and relevant passages and verbatim quotes were manually assigned to the four “macro” categories of the coding framework in NVivo. As a result, we obtained 26, 28, 31 and 28 papers in the “value”, “characteristics”, “stakeholders” and “process” categories, respectively (Table 2). As we proceeded with reading and coding the papers, we were able to identify more specific research themes within each category, thereby expanding our initial coding framework to 12 categories (Table 2).

To measure coding reliability, we calculated Krippendorff’s alpha (K-alpha) which was equal to 0.8 (Hayes and Krippendorff, 2007; Massaro *et al.*, 2016). Any coding discrepancies were resolved by the coders through a discussion of the full paper texts. In parallel, the papers were summarised in a spreadsheet in terms of their research focus, theoretical approach, geographical context, methodology and key insights.

## 4. Analysis and results

Several important observations emerge from the analysis of our literature sample (Table 3). First, while the amount of published research on the topic has grown significantly over the examined period, 88% of relevant studies have been concentrated in business, management and accounting and social sciences. Second, related research is diffused across a broad range of academic outlets. Third, from a methodological standpoint, essays and discussion pieces account for the largest share (48) of the sample. Fourth, the sample is dominated by research which is not grounded in any existing theory (65%). Among the papers that adopt a theoretical lens, dynamic capability and resource-based views, stakeholder and actor-network theories are most frequent, jointly accounting for 15% of the papers reviewed. Hence, our findings indicate that no dominant theory explaining the relationship between BDA, corporate accountability and NFD has been established yet. Over 20% of the papers in our sample address the topic using a wide array of distinct theories and frameworks, which are often taken from different fields (e.g. normal accident theory). Finally, whereas the majority of papers are not tied to any particular geographical area (54%), research in the context of North America (17%) and Europe (13%) is carried out more frequently.

Code	Coding categories	No. of papers
1	<i>Value</i>	26
1.1	Transforming decision-making process	
1.2	Value creation and capture	
1.3	Enhancing social and environmental systems	
2	<i>Characteristics</i>	28
2.1	Technical features of BDA	
2.2	Data-driven insights	
2.3	Information disclosure and reporting	
3	<i>Stakeholders</i>	31
3.1	Distribution of power between stakeholders	
3.2	Data-enabled collaborations	
3.3	Stakeholder engagement and accountability	
4	<i>Process</i>	28
4.1	Privacy and informed consent	
4.2	Algorithmic accountability	
4.3	Environmental and security risks	

**Table 2.**  
Coding categories  
and identified  
research themes

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14,7

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	Frequency	(%) of total
<i>Subject area</i>		
Business, management and accounting	69	61
Social sciences	31	27
Environmental sciences	5	4
Decision sciences	4	4
Computer science	4	4
<i>Method</i>		
Discussion/Essay	54	48
Qualitative	35	31
Quantitative	17	15
Mixed methods	7	6
<i>Theory/framework</i>		
No theory used	73	65
Dynamic capability view	6	5
Resource-based view	4	4
Stakeholder theory	4	4
Actor network theory	2	2
Other <sup>a</sup> (<1%)	24	21
<i>Geography</i>		
North America	19	17
Europe	15	13
Asia	13	12
Latin America	2	2
Africa/Middle East	2	2
Australia Pacific	1	1
Not limited	61	54
<i>Journal representation in the sample</i>		
<i>Journal of Cleaner Production</i>	11	10
<i>Technological Forecasting and Social Change</i>	6	5
<i>International Journal of Information Management</i>	5	4
<i>Journal of Business Ethics</i>	5	4
<i>Meditari Accountancy Research</i>	5	4
<i>Business and Society</i>	3	3
<i>Critical Perspectives on Accounting</i>	3	3
<i>Ethics and Information Technology</i>	3	3
<i>Journal of Management Information Systems</i>	3	3
Other journals (<3%)	69	61
<i>Publication timeframe</i>		
2014	3	3
2015	3	3
2016	7	8
2017	14	12
2018	24	22
2019	37	33
2020	5	4
2021	17	15

**Table 3.**  
Summary of the  
reviewed papers

**Notes:** <sup>a</sup>Theories and frameworks that were used only once were assigned to “Other” category. Examples include normal accident theory, Nissenbaum’s theory of “privacy as contextual integrity” and Bentham’s utility theory

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The remainder of this section is outlined in four subsections corresponding to the four conceptual categories of the coding framework.

#### 4.1 Value

This subsection reviews the papers that investigate the motives and the valuable implications of the relationship between BDA and NFD. Three main themes have been identified:

- (1) the transformation of corporate decision-making processes;
- (2) value creation for both users and provider companies; and
- (3) enhancing social and environmental management systems.

*4.1.1 Transforming decision-making processes.* The extant literature has related companies' implementation and use of BDA to the co-existence of interactions between different stakeholders from different contexts and to the creation of unprecedented amounts of data for different purposes (Urbinati *et al.*, 2019). Most of the time, the data generated as a result of these interactions are non-financial in nature (Kang *et al.*, 2021). If properly performed, then BDA reveals economic trends, favours improvements in products and services and supports advertising and marketing while monitoring all their effects. Drawing on the stakeholder theory, Barchiesi and Fronzetti Colladon (2021) empirically analyse how BDA enables corporations to increase awareness and deepen the understanding of their stakeholders' needs, prevent or quickly resolve arising issues and improve stakeholder communications. Therefore, BDA affects the corporate way of defining its business model and managing its organisation and decision-making process (Tseng *et al.*, 2019).

In this way, the corporate decision-making process can incorporate both qualitative and quantitative data to understand the effects, reactions, opportunities and challenges of different actions, reducing the costs of taking unexpected risks and aiming at developing and sustaining a competitive advantage. For this reason, BDA is used to profile, address and forecast customers' needs and requirements, favouring customised production and personalised supply (Andrew and Baker, 2021). Corporate decision-making processes based on such relevant BDA become vital for monitoring cost-effective performance and improving corporate competitive advantage (Gružauskas *et al.*, 2018). For instance, Lassila *et al.* (2019) apply the actor–network theory to show how analysing real-time information on customers' activities has helped to fine-tune the product offering in the gaming industry.

Furthermore, some scholars have discussed how the role of the accounting function in organisational decision-making has increased as a result of BDA (Bhimani and Willcocks, 2014). That is, financial accounting data have gained a new significance as they are being combined with non-financial information, critically elaborated by accountants and disclosed through proper channels of communication. This process resembles a continuous cycle in which the disclosed accounting data not only influence the decision-making of other stakeholders but also generate additional data through interactions with them (Neu *et al.*, 2019).

*4.1.2 Value creation and capture.* The extant literature points out that the integration of different types of data from various sources helps decision-makers, favours the development of competitive advantage (Waqas *et al.*, 2021) and may increase corporate profit (Blasi *et al.*, 2021; Urbinati *et al.*, 2019). Conversely, other studies have raised concerns about assessing the monetary value of data from an accounting perspective (Abella *et al.*, 2017). Drawing on resource-based view (RBV) of the firm, Mamonov and Triantoro (2018) show that the temporal decoupling between value creation and value capture can interfere with the firm's ability to capture full value created through the investment in data resources. Grover *et al.* (2018) emphasise that creating and capturing value from data is only possible by deriving



insights through the use of BDA and human judgement: according to the dynamic capability view, a significant investment in skilled analysts and BDA capabilities (not only in data infrastructure and analytic technologies) is required to achieve business value.

For these reasons, appropriate information management systems and human analytical skills become crucial. They represent value creation capabilities (Ratia *et al.*, 2018) to select, explore and analyse data; develop BDA capabilities and permit the integration of data; and generate information, which is disclosed after the proper evaluation of opportunities and risks. Indeed, according to signalling theoretical framework, effective information about corporate actions and about the quality of corporate offerings (especially about sustainability and CSR communications) translate into positive market responses (Blasi *et al.*, 2021). All these items together become valuable because they impact organisational results, such as process improvement and product innovation (Grover *et al.*, 2018). Therefore, managers can orchestrate the described resources and integrate them to create value and improve corporate performance (Zeng and Khan, 2018). According to the relationship marketing theory, the humanized view of customers (instead of the mechanical view of traditional customer analytics) permits managers to gather customers' perceptions, preferences, interactions and preferred channels of communication through BDA, enabling them to extract value from data constructs (Kitchens *et al.*, 2018).

*4.1.3 Enhancing social and environmental management systems.* There is an emergent stream of literature exploring how BDA impacts corporate actions to mitigate climate change (Roman Pais Seles *et al.*, 2018). Seizing the potential opportunities deriving from such risk, BDA may lead to new business solutions (e.g. less intensive and consuming production systems), favouring better communication with stakeholders, increasing efficiency (e.g. reducing costs) and improving corporate performance (Song *et al.*, 2019; Zhu *et al.*, 2021).

Several studies have also examined how governments can promote cooperation among organisations attempting to mitigate climate change through BDA. The actions promoting public-private partnerships should represent effective means to achieve global goals for environmental sustainability rather than extractive and profit-oriented data practices (Espinoza and Aronczyk, 2021). Such cooperation is also useful in reducing waste and increasing recycling, as planned by the circular economy (Jabbour *et al.*, 2019). Even in this case, BDA may provide relevant non-financial information (e.g. about the product's life cycle), enhancing sustainability (Soni *et al.*, 2021) and increasing corporate social-environmental performance. The Sustainable Development Goals of the 2030 Agenda proposed by the United Nations promote the achievement of sustainable value creation through sustainability initiatives both at the societal and organisational levels (Al-Htaybat and von Alberti-Alhtaybat, 2017). In such context, achieving a sustainable business development goal for organisations should be supported by a combination of resources, capabilities and favourable external conditions according to the contingent RBV (Jeble *et al.*, 2018). From this perspective, organisational context and managerial action support corporate value creation not only by focusing on data collection, storage and analysis, but also by setting precise goals and aligning them with business strategies, skills and capabilities (Müller and Jensen, 2017).

A decision-making process exploiting BDA applications may promote the development of sustainable organisational practices, such as environmental initiatives and the training/qualification of employees (Singh and El-Kassar, 2019). Moreover, it helps both the prediction and communication of unsustainable practices in terms of attempts to monitor and manage social, ethical and environmental risks, both in the short and long term (De Camargo Fiorini *et al.*, 2019). Specifically, prediction helps to forecast future (negative) events and evaluate indicators (e.g. unemployment levels), market trends, policies and

public grants (Tseng *et al.*, 2019). Communication promotes the transparency and dissemination of sustainable actions to both internal and external stakeholders through a growing number of communication channels.

A particular stream of literature emphasises the positive communicational effects deriving from continuous information flows throughout the supply chain (Smith *et al.*, 2019). This provides organisations with an important data source of non-financial information and valuable insights about sustainability practices, preciously complementing information obtained from other (more popular) channels.

Given the benefits, proactive organisations have begun to create sustainable supply chains as a form of effective operational management with minimal unsustainable effects. They aim to reconsider their business models and operations according to social and environmental needs with regard to safe drinking water, child labour, gender equality, education, health facilities and the consumption of natural resources (Dubey *et al.*, 2019). Yet, there is a trade-off between cost-effective performance and sustainability that need to be minimised, maybe thanks to innovative technologies, increased visibility and coordination among partners (Gružauskas *et al.*, 2018). In addition to improvements in process efficiency and the creation of compliance with the legislation, committed managers try to identify opportunities to reduce the use of materials and energy, as well as to improve society (De Camargo Fiorini *et al.*, 2019). BDA could enhance not only the positive relationship between informational sustainable management systems as based on the collection but also the disclosure of sustainable practices to stakeholders. BDA offers opportunities for existing companies to renew their business models and discover further (also intangible) value drivers (Secundo *et al.*, 2017).

#### 4.2 Characteristics

This subsection analyses papers investigating BDA that can be organised around three themes:

- (1) technical features of BDA;
- (2) data-driven insights, and
- (3) information disclosure and reporting.

*4.2.1 Technical features of big data analytics.* Data collected from both internal and external sources may be structured or unstructured (Bhimani and Willcocks, 2014). The volume and variety of such data (Saggi and Jain, 2018) often do not correspond to a high quality, requiring additional technological tools and human expertise to filter data for decision-making purposes and value creation (Rehman *et al.*, 2016). Indeed, many technological tools are emerging for collecting, storing and processing large data sets (e.g. the Internet of Things, cyber-physical systems, the Internet of Services, blockchain and BDA). They are characterised by great connectivity (Al-Htaybat and von Alberti-Alhtaybat, 2017) and help organisations to keep pace with BD characteristics by also trying to capture continuous flows of real-time data in digital form at their inception. This digital data streaming aims to dissect events in real time, report every state change and capture all events in digital format (Pigni *et al.*, 2016). Many organisations do not have these systems and technologies to collect BD and respond rapidly to an evolving informational environment (Addison *et al.*, 2018; Raut *et al.*, 2021). Moreover, the usual “what-if” doubt still represents a significant barrier for investments in BDA (Tiwari and Khan, 2020).

Even when available, technology provides new tools and new informational possibilities, but it is not an end in itself. In this sense, BDA becomes (and needs to be considered as) a

resource (Arnaboldi *et al.*, 2017): BD have no value in themselves, but they become valuable when collected and applied in particular organisational and business contexts (Müller and Jensen, 2017). Technology favours the creation of real value through BDA application. For instance, Seele (2017) proposes a control system, which uses BDA to build a database of past corporate scandals affecting sustainability, to predict (and potentially prevent) future social and environmental disasters, towards a new paradigm of BD-driven sustainability theory.

*4.2.2 Data-driven insights.* BD collection is relatively easy, but many of them originate from external sources and are different from the traditional business intelligence data usually adopted across the company. Therefore, organisations need to be sensitised to different types of knowledge, understanding the challenging difference between data and information (Bhimani and Willcocks, 2014). Advanced technologies for data analysis help managers to uncover useful information (e.g. unknown patterns) and make better decisions across corporate business processes. According to the dynamic capabilities theory, BDA helps organizations establishing knowledge creation routines particularly when market dynamism is high. While BDA can be viewed as an organisational information processing capability that reduces uncertainty by stimulating insights and knowledge creation, recent studies reveal that a majority of companies have not begun to capitalise on BDA (Chen *et al.*, 2015). Such organisations appear to still be in the previous learning stage, trying to understand the value and risks, technological investments and analytical skills associated with BDA. The advent of BDA has augmented both the magnitude and speed of both corporate risks and opportunities, requiring a revision of traditional managerial tools and solutions (De Santis and Presti, 2018). For instance, accounting and control functions need substantial changes and coordination efforts (Vollmer, 2019) because they have been traditionally based on a deductive approach using stable rules and structures. The extant literature reveals that BDA has already changed corporate accounting and accountability but that this has happened indirectly through changes external to accounting functions (e.g. in marketing departments).

Moreover, BD are (or are derived from the combination of other) data not specifically generated for business use in most cases (Arnaboldi *et al.*, 2017). Their governance includes a range of control actions for facing informational risks. The lack of total ownership over data implies concerns related to reliability, privacy and surveillance (Andrew and Baker, 2021) and managers' attempts to protect the reputation capital of their organisations (Arnaboldi *et al.*, 2017). Research has emphasised the lack of transparency regarding data sets and BDA: while BDA results and representations are rapidly and publicly available, their source codes and algorithms are rarely accessible. Moreover, Foucauldian-inspired studies of surveillance on materiality, knowledge creation and governance suggest that mediating technologies influence the transformation of data into knowledge and they are not neutral, imposing certain constraints on the nature and type of possible communications (Hansen and Flyverbom, 2015). They are often based on the collection and aggregation of BD from very different sources and use mathematical correlations and patterns suggestive of expected behaviour without causality or conclusive reasoning. Indeed, BDA has changed the corporate information available in three predominant ways (Fawcett and Waller, 2014). First, correlation substitutes causality in the transformation of data to information for making decisions. Second, BDA can be used and manipulated to construct realities that make "comfortable" corporate narrative appear to be supported by data-based evidence (Lippert, 2016). Third, customers' profiling represents a main source for corporate prediction, but companies do not know the exhaustiveness and representativeness of BDA either (Arnaboldi *et al.*, 2017): Do such data and analytics refer to the entire (or only part of) the population? All these risks and control concerns must be disclosed and taken into

account to see BDA as a resource for decision-making processes that is not based on automating individual and organisational responses but still characterised by humans' capacity to reflect and think critically (Lippert, 2016).

*4.2.3 Information disclosure and reporting.* BDA also displays the potential to simplify, spread and improve disclosure about social and environmental issues. BDA could even lead to an effective personalisation of default rules and disclosure (Porat and Jacob Strahilevitz, 2014) in both legal and social matters (e.g. medical negligence, labour law, consumer contracts and organ donation). Moreover, BDA enables new disclosure tools (e.g. websites, online reports, blogs and social media platforms) for both reporting and communicating non-financial information to a wide range of stakeholders in a prompt way, reducing information asymmetry (Albarrak *et al.*, 2020). Di Porto and Zuppetta (2021) propose an "algorithmic" form of disclosure which co-developed and pre-tested jointly by regulators, businesses and users but is done by BDA. The authors argue that such algorithmic form of disclosure is more effective, as it allows for immediate implementation of amendments and targeted disclosure towards the interests of specific stakeholder groups.

The main features of such non-traditional disclosure tools appear highly valuable as reporting becomes real-time (in addition to periodic reporting), widely spread (gathering a multitude of stakeholders, both accountants and non-accountants, both local and worldwide users), easy (to both prepare and deliver), dialogic (allowing to interact with stakeholders) and appropriate (providing a huge variety of contents and many insights into how business impacts society). These represent new reporting avenues based on online media that complement the traditional ones and provide relevant disclosure channels (e.g. about specific and relevant non-financial issues) and also BD sources (Ndou *et al.*, 2018).

The alteration of corporate reporting through BDA requires finding solutions to a number of initial paradoxes, such as reliability versus timeliness, data simplicity versus algorithm complexity, transparency versus privacy and empowerment through tools versus enslavement to media (Arnaboldi *et al.*, 2017). The transparency issue remains the most significant as information and knowledge becomes mediated through BDA (Hansen and Flyverbom, 2015).

Finally, several studies in our review have addressed the role of governments and non-profit organisations in promoting data-driven sustainability disclosure. By comparing the quality of the environmental information disclosure systems across regions in China, Kosajan *et al.* (2018) have concluded that governmental disclosure enhances the implementation of environmental regulations and, consequently, improves the local socioeconomic and ecological situation. Furthermore, scholars have examined opportunities and challenges that BD present for the traditional models of certifications and auditing used by sustainability standard-setting organisations (Gale *et al.*, 2017) and for national statistics offices designing social indicators (di Bella *et al.*, 2018).

### 4.3 Stakeholders

In this subsection, we analyse the extant research on the impact of BD on various stakeholder groups and the relationships between them. We report the key insights in accordance with the three identified research streams within the broader "stakeholder" category:

- (1) the distribution of power between stakeholders;
- (2) data-enabled collaborations; and
- (3) stakeholder engagement and accountability.

*4.3.1 Distribution of power between stakeholders.* The first research stream is concerned with understanding how BDA alters the power relations between different stakeholder groups. To that end, several studies suggest that digitalised society is characterised by a power shift from individual users that generate data towards private corporations and governments that own and control user data (Flyverbom *et al.*, 2019; Leszczynski, 2015; Malthouse *et al.*, 2019; La Torre *et al.*, 2018). Such power disparity stems from unequal access to resources and capabilities needed to access, store and process BD (Lock and Seele, 2017) and is compounded by the growing ability of private businesses to control and manipulate user behaviour through predictive algorithms (Andrew *et al.*, 2021; Andrew and Baker, 2021).

Literature provides empirical evidence of how BDA empowers businesses to use predictions of human behaviour for commercial purposes. For example, in a multiple case study of the Chinese financial industry, Kshetri (2016) applies transaction costs theory and shows how banks overcome information asymmetry and adverse selection problems by evaluating clients' ability and willingness to repay loans based on their non-financial information (e.g. online shopping behaviour and social media activity) procured from internet companies. Along similar lines, Aitken (2017) demonstrates how non-financial information can be used to assess the creditworthiness of "unbanked" citizens without financial credit histories. Furthermore, Steinberg (2020) explores an extreme but theoretically possible case of data-enabled personalised pricing, which would further undermine the power of individual consumers in the market by eliminating consumer surplus entirely.

Conversely, some studies suggest that data-enabled control can be used as a means to a benevolent end. A paper by Seele (2016) draws on Bentham's utility theory to demonstrate how ubiquitous digital surveillance can be potentially used as a power instrument for steering citizens' behaviour in a more sustainable direction. On a similar note, Ferguson (2019) contemplates the possibility of fostering police accountability by tracking police misconduct through the same data-driven surveillance technology infrastructure used by the police to monitor citizens' criminal activities.

Finally, Chenou and Radu (2019) offer a different perspective as to how power relations between private BD companies and public institutions are being recalibrated. By analysing the events surrounding the decision of the Court of Justice of the European Union to allow Google to exercise discretionary power in addressing the "right to be forgotten" requests, the authors provide evidence of how Google has been delegated new functions that were previously in the domain of responsibility of legal institutions.

*4.3.2 Data-enabled collaborations.* The second research stream evidences two main ways in which BDA impacts collaborations between stakeholders. First, several papers examine the emergence of ecosystems that co-create business and societal value through stakeholder collaborations based on exchanging data across organisational boundaries (Malthouse *et al.*, 2019; Rasche *et al.*, 2019; Uden and Del Vecchio, 2018; Vecchio *et al.*, 2018). Second, research shows that BDA is conducive to more sustainable consumption and production between partners (Dubey *et al.*, 2018; Melander and Pazirandeh, 2019). For instance, Freidberg (2020) investigates how BDA enables sustainability collaboration between large manufacturers and small farmers in the agricultural value chain. Drawing on the stakeholder theory, Gupta *et al.* (2019) demonstrate that stakeholders in the circular economy maximise resource use and reduce the negative environmental impact by sharing data and information. Zhu and Li (2021) show how a blockchain-based information exchange platform can be used for cross-regional agricultural data sharing and sustainable decision-making.

Notwithstanding the benefits of data-enabled collaborations, several studies point out the challenges that they may present. For instance, in their analysis of inter-firm data partnerships in the agricultural sector, [Coble et al. \(2018\)](#) draw attention to the issues of data ownership and integration as well as to the inherent disadvantages of collaboration partners located in rural areas with poor technology infrastructure. In the context of sustainability development in smart cities, [Pincetl and Newell \(2017\)](#) discuss the issues of data quality and completeness, which occur when partners use the data for purposes that differ from those for which the data were originally collected.

*4.3.3 Stakeholder engagement and accountability.* The third research stream on how BDA increases the role of stakeholders in enhancing corporate accountability has progressed in two main directions. On the one hand, BDA can be instrumental in increasing corporate accountability by means of operational transparency and predictive analytics. To that end, [Shukla and Tiwari \(2017\)](#) have examined how preventive BDA limited misreporting and improving the traceability of operations in the agricultural sector. Furthermore, BDA enables companies to simulate possible future scenarios, anticipate negative outcomes of their decisions and inform their stakeholders about social and environmental risks *ex ante* ([Wilburn and Wilburn, 2016](#)). Furthermore, [Shafiq et al. \(2020\)](#) adopt a stakeholder theory and RBV to empirically explore employee-focused corporate social practice and provide additional evidence that data-driven supply chain capabilities are synergistically reinforced by customer pressure for ethical conduct.

On the other hand, scholars have analysed how BD generated through social media can enhance accountability by enabling more participative stakeholder governance. New forms of media were found to enhance inclusive public participation in making public authorities accountable ([Bagozzi et al., 2019](#); [Ojala et al., 2019](#); [Saxton and Neu, 2021](#)) and increasing public visibility of activists' and whistle-blowers' claims ([Olesen, 2020](#); [Uldam, 2018](#)). To that end, social media serves as a medium through which individuals can voice their concerns and dialogue with companies regarding their corporate social responsibility activities ([Barbeito-Caamaño and Chalmeta, 2020](#); [She and Michelin, 2019](#)). Along similar lines, [Sivarajah et al. \(2020\)](#) discuss how Web-based platforms are used to communicate sustainability, identify the most powerful stakeholders and analyse customer sentiment in real time.

Whereas the potential of social media in enhancing corporate accountability *vis-à-vis* its stakeholders has been acknowledged, scholars share a certain degree of scepticism with regards to the ability of social media conversations to induce companies to change their behaviour. For instance, [Ojala et al. \(2019\)](#) demonstrate that social media accountability claims remain ineffective unless supported by traditional news media, political and governmental figures. Conversely, [Saxton and Neu \(2021\)](#) assert that a combination of value-based ethical messaging with information about the monetary magnitude of an event help to maintain the interest of the audience towards accountability claims on social media. [Uldam \(2018\)](#) suggests that companies may exploit activist visibility to their advantage by monitoring, anticipating and preventing activist criticism. Drawing on organisational hypocrisy theory, [She and Michelin \(2019\)](#) propose that firms use social media to maintain legitimacy and manage stakeholder perceptions rather than to mitigate stakeholder concerns. [Hoeyer \(2019\)](#) argues that more intensive data collection in a public sector can result in the temporal "disruption" of accountability, which legitimises the postponement of immediate action under the excuse of "waiting" to accumulate enough data to take a decision.

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#### 4.4 Process

This subsection reviews the extant research that addresses the questions of accountability in the context of BD collection, storage and processing. The three identified research themes within the “process” macro topic are privacy and informed consent, algorithmic accountability and environmental and security risks.

*4.4.1 Privacy and informed consent.* The first stream of literature deals with the ethical issues regarding data collection from individuals and the lack of transparency when getting informed consent from users. To that end, a substantial body of literature examines privacy and transparency issues with data collection in education (Regan and Jesse, 2019), health care (Ballantyne, 2019; Cato *et al.*, 2016), academic research (Markham *et al.*, 2018) and law enforcement (Ferguson, 2019).

Literature also provides critical analyses of the effectiveness of the existing measures to mitigate privacy issues. For instance, based on an analysis of the EU General Data Protection Regulation, Andrew and Baker (2021) conclude that the data anonymisation creates an “ownerless” legal status of data, which precludes users from claiming ownership of their data. Pascalev (2017) questions the adequacy of privacy terms and conditions disclosure as a means of obtaining user informed consent because of the “practical impossibility” for a user to read and understand them. Furthermore, several authors suggest that successfully addressing privacy and consent issues in an organisation is rooted in corporate ethical strategies and high-level principles (Arthur and Owen, 2019; Cool, 2019; La Fors *et al.*, 2019; Zimmer, 2018). In addition, some studies highlight strategies that users develop to mitigate privacy concerns on their end (Leszczynski, 2015; Miltgen and Smith, 2019).

*4.4.2 Algorithmic accountability.* The second research stream discusses the implications of algorithmic recommendations for the accountability of decision-makers as well as ethical dilemmas that stem from data-based decision-making. To that end, algorithms may result in biased outcomes if the existing data or the code reflect pre-existing discrimination in the society against disadvantaged groups based on race, gender or social status (Martin, 2019). The inherently “opaque” nature of self-learning algorithms further exacerbates the problem and results in so-called “accountability gaps” (Bennett Moses and Chan, 2018). Such accountability gaps refer to unclear mechanisms of the attribution of accountability to humans for decisions informed by autonomous algorithms and have been identified in academic research (Markham *et al.*, 2018), public administration (Busuioc, 2021), professional services (Fenwick and Edwards, 2016), preventive policing (Bennett Moses and Chan, 2018), education (Fynn, 2016), health care (Cato *et al.*, 2016) and accounting (Moll and Yigitbasioglu, 2019).

A significant part of the research in this stream is concerned with how professional accountability and responsibility are allocated in relation to an individual and an algorithm (Campbell-Verduyn *et al.*, 2017; Fenwick and Edwards, 2016; Kempeneer, 2021; Martin, 2019; McGregor *et al.*, 2019). To that end, Martin (2019) proposes a theory of algorithmic accountability suggesting that firms that develop an algorithm should be accountable for the amount of responsibility that is allocated to individuals in the decision-making process and for the ethical implications and biases of that algorithm. Conversely, Fenwick and Edwards (2016) sustain that responsibility for examining and understanding the risks of algorithmic bias lies with a human decision-maker. Along similar lines, McGregor *et al.* (2019) argue that inability to predict algorithmic outcomes does not absolve individual decision-makers from responsibility for them.

While scholars tend to agree that accountability for an algorithmic decision should be attributed to a human agent, there are different perspectives on whether algorithmic

accountability should be enhanced through data-focused professional education (Fenwick and Edwards, 2016), embedding human rights considerations in algorithm design (McGregor *et al.*, 2019), disclosing algorithmic codes and documentation to the general public (Kemper and Kolkman, 2019) or mutual exchange of knowledge and information between parties involved in algorithmic decision-making (Kempeneer, 2021).

*4.4.3 Environmental and security risks.* The third stream of research discusses data-related environmental and security risks as well as organisational practices that companies adopt to mitigate them. The first line of research draws attention to the environmental issues that emanate from BD processing and storage (Corbett, 2018; Edwards, 2021). While scholars acknowledge the efforts of data service providers in prioritizing renewable energy sources, they are concerned that an “immaterial” and “sustainable” image of data-related services that technology companies have been propagating diverts public attention from the environmental footprint and natural resource consumption of BD infrastructures (Edwards, 2021).

The second line of research addresses the role of employee competences (Akhtar *et al.*, 2018; Gul *et al.*, 2021) and organisational processes in ensuring the ethical, sustainable and secure use of BD. Drawing on a normal accident theory, Nunan and Di Domenico (2017) emphasise the role of human action as a cause of data-related ethical and security problems and call for strengthening organisational practices to prevent employees from accidental data leaks and security breaches. Along similar lines, La Torre *et al.* (2018) provide a critical overview of data-related risks and challenges and conclude by evidencing the need to adjust accounting information and corporate reporting to reflect the emergent forms of data-related accountability for user data privacy and security issues.

## 5. Discussion

The discussion is organised into two sections following the framework by Alvesson and Deetz (2000). First, the “Insight and critique” section synthesises, interprets and critically examines the established body of knowledge on the relation between BDA, accountability and NFD across the four macro categories. Second, the “Transformative redefinition” section offers alternatives to the established assumptions and outlines knowledge lacunae for orienting future research efforts.

### 5.1 *Insight and critique*

Whereas accountability in the BD era is a recurring theme in our review, only a few studies discuss the role of BDA in corporate reporting (Al-Htaybat and von Alberti-Alhtaybat, 2017; Arnaboldi *et al.*, 2017; Bhimani and Willcocks, 2014; La Torre *et al.*, 2018), and no articles explicitly address its role in NFD, specifically. Drawing on our analysis, we distinguish between two different but not mutually exclusive approaches to BDA that companies may adopt: BDA as a *value creation instrument* or as a *revenue generation source*.

*5.1.1 Big data analytics as a value creation instrument.* We refer to BDA as a *value creation instrument* when the commercial interests of a company are aligned with its stakeholder needs and the company uses BDA as a means to create long-term value for its stakeholders. In this case, the company revenues derive from product sales, and BD are collected as a by-product of the core activity and are used either as a source of non-financial information (Dubey *et al.*, 2019; Urbinati *et al.*, 2019) or as an input for algorithms (Lassila *et al.*, 2019) that inform management decisions.

The precision and granularity of such data-driven information increase the objectivity of managerial decisions (Grover *et al.*, 2018; Gružauskas *et al.*, 2018; Ratia *et al.*, 2018) and minimise risks through preventive analytics (Kitchens *et al.*, 2018; Zeng and Khan, 2018).



In addition, the technical characteristics of BD are leveraged for implementing real-time, interactive forms of disclosure that increase stakeholder connectivity and participation (Al-Htaybat and von Alberti-Alhtaybat, 2017; Neu *et al.*, 2019). Furthermore, because businesses regard BDA as a means to accomplish sustainability goals, they are more likely to relinquish control over their data (Gupta *et al.*, 2019) and ensure the transparency of data collection and processing (Arthur and Owen, 2019).

These views can be criticised along several dimensions. First, a number of studies have challenged the idea that data-based managerial decision-making ensures sustainable outcomes. On the one hand, algorithms are programmed to deliver outcomes that benefit the organisations that use them and are maybe “trained” with regard to flawed input data. Therefore, data-informed decisions cannot be considered truly impartial and unbiased (Martin, 2019; Quattrone, 2016). Moreover, managerial priorities become shaped by data availability and measurability. As a result, problems for which no data exist do not receive the same attention as those for which measurable outcomes are readily available (Freidberg, 2020; Quattrone, 2016).

Second, organisations have been criticised for obtaining data-driven efficiency gains at the expense of continuous location-based tracking and the pervasive performance control of their workforce (La Torre *et al.*, 2018). Third, while there is a growing expectation from companies to become more data-driven, it is not a level playing field for smaller firms in rural areas or developing countries, which suffer from undeveloped internet infrastructure and cannot afford the “luxury” of BDA without a concrete understanding of the return on BDA investment (Coble *et al.*, 2018; Fawcett and Waller, 2014; Grover *et al.*, 2018).

Finally, there is a lack of awareness of the negative environmental impact of BD storage and transmission. Apart from a notable exception (Corbett, 2018), research has one-sidedly considered the use of BD as beneficial for increasing sustainability without questioning whether BD infrastructure in itself can be a source of environmental concern in a long-term perspective.

*5.1.2 Big data analytics as a revenue generation source.* Conversely, we refer to BDA as a *revenue generation source* if a company relies on user data commoditisation and monetisation as core elements of its business model. An example is a company that sells its user data to third parties in pursuit of profit or that uses user data to train algorithms, which ultimately aim to commercially exploit user vulnerabilities.

Much of the established literature critically addresses the consequences of ubiquitous for-profit data gathering by businesses. Because companies view data accumulation as an end in itself, they often pursue it at the expense of user privacy, security and freedom. More often than not, companies obtain user permission to collect and process data without users fully understanding the terms and conditions they are agreeing to (Pascalev (2017). Furthermore, pressure to extract profitable insights from data pushes organisations to store large amounts of data indefinitely, thus exposing users to security threats and privacy breaches (La Torre *et al.*, 2018). Finally, the limitation of user freedom takes place when the data are used for manipulating their commercial preferences and subtly inducing purchase behaviour that benefits the business (Andrew and Baker, 2021).

Conversely, a counter critique of the established assumptions points out that users are often complicit in privacy and security violations as they knowingly expose their data in exchange for convenience and free services (Nunan and Di Domenico, 2017). Moreover, users are willing to engage in online transactions precisely *because* all their activities are being monitored, controlled and recorded by companies (Whelan, 2019). Last but not least, while aforementioned data-related issues are more likely to be observed in companies that

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monetise data, they can inadvertently surface in all organisations that collect data even if they do so to create societal benefits (e.g. citizen surveillance for security purposes).

Taken together, our insights indicate that the nature of the relationship between BDA and accountability depends on whether an organisation considers BDA as a *value creation instrument* or as a *revenue source*. In the former case, the use of BDA enhances corporate accountability for companies' *core* activities, and yet, it does not absolve them from responsibilities regarding data-related risks. In the latter case, BDA extends the magnitude and the scope of risks for which companies should be held accountable. Therefore, there is a call for new mechanisms of corporate accountability for ethical, societal, security, privacy and environmental risks resulting from BDA. In the next section, we discuss if NFD can be applied as an effective accountability mechanism in a new data economy.

### 5.2 Transformational redefinition

The logic behind NFD implies that publicly revealing information about the environmental, social and ethical consequences of organisational actions enables stakeholders to challenge these actions and hold the organisation accountable for them. However, the effectiveness of NFD as a means of enhancing accountability in the BDA domain has been questioned along several lines. First, companies are reluctant to publicly disclose proprietary data and algorithm-related information if these constitute the main source of their unique competitive advantage (Hansen and Flyverbom, 2015). Second, disclosing raw input or training data sets can be harmful, as it can reveal sensitive information about the users. Third, transparency *per se* is ineffective when an algorithm is an object of disclosure. That is, given the complexity of algorithms, disclosing them to the general public is impractical, as most people are unable to understand them (Kemper and Kolkman, 2019). Furthermore, the self-learning nature of algorithms obfuscates the process by which outcomes are produced and diffuses responsibility for data-driven decisions (Markham *et al.*, 2018; Martin, 2019).

Notwithstanding the aforementioned limitations, there are four mechanisms through which we believe NFD can influence corporate accountability in the BDA context:

- (1) enhanced quality;
- (2) dialogic exchange;
- (3) algorithmic transparency; and
- (4) social and environmental disclosure.

The extent to which each mechanism can be applied to enhance accountability, so we argue, will depend on whether a company uses a value creation or revenue generation logic to BDA.

For companies that use BDA for value creation, such analytics can enhance the *quality of NFD* by providing more real-time quantitative information for setting precise targets and improving progress measurability. As a consequence, quantitative performance measures will increase the timeliness, consistency and comparability of sustainability information across different companies for the stakeholders. Yet, it is important to acknowledge that not all companies have equal conditions for developing data-driven tools to measure operational sustainability.

Furthermore, NFD can be used as a *dialogical tool* that informs company stakeholders about sustainability performance and enables them to express their position with regard to which metrics matter and what sustainability issues need to be addressed (Kempeneer, 2021; Di Porto and Zuppetta, 2021). In this case, stakeholder feedback presents the possibility of

addressing the long-standing issue of companies “marginalizing what cannot be counted” (Quattrone, 2016, p. 120) and compelling managers to solve meaningful problems for which no data exist.

Instead, when companies primarily use BDA to generate revenues, NFD can partially alleviate concerns about the lack of *algorithmic accountability*. For instance, even though the full disclosure of an algorithm is neither feasible nor desirable, the intentions and the logic underlying the design of an algorithm, as well as the input and training data that are fed into it, need to be disclosed. As a result, the stakeholders will be better positioned to judge whether an algorithm suffers from bias and to contest its discriminatory outcomes. However, algorithmic transparency alone is insufficient unless stakeholders (e.g. users) can access and control their own data. To that end, NFD should empower users by revealing information on how their data has been used, when, by whom and for what purpose. Interestingly, algorithms themselves can become a part of a solution by assisting regulators and companies in generating, updating and targeting information disclosure to the users’ needs (Di Porto and Zuppetta, 2021).

Finally, NFD should increase accountability for *environmental and social risks* resulting from BDA use. On the one hand, NFD should include accounts of the material consequences of the processing of large amounts of data, its related infrastructural requirements in terms of energy and its ecological impact. On the other hand, NFD should reveal additional social risks, which include, but are not limited to, the unregulated human labour involved in routine data-related activities (i.e. click workers), pervasive employee surveillance and workforce deskilling and replacement. In a broader sense, environmental footprint and social implications should be considered at the level of the entire system of BDA suppliers and distributors, ranging from mineral extraction to the disposal of hardware and its components.

## 6. Conclusion

The present paper used an SLR and identified 12 research themes that deal with the relationship between BDA, corporate accountability and NFD. The results of such analysis were then discussed following a specific framework by Alvesson and Deetz (2000) and presented by distinguishing between two complementary corporate approaches to BDA as a value creation instrument or as a revenue generation source. In this way, the paper can answer the three initial research questions.

First, the sampled papers on the role of BDA in corporate accountability still refer to a stream of research in its infancy. Moreover, there are no papers specifically addressing its role in NFD. According to findings of our study, the published research has progressed in two major directions. On the one hand, BDA is regarded as beneficial to organisations in terms of improving the quality of decision-making, reducing the chance of error and impacting on societal value creation. On the other hand, these benefits can be offset by challenges related to the collection, storage and processing of data. To sum up, our analysis indicates that BDA *per se* does not make companies more accountable and simultaneously represents the source and a part of a solution to corporate accountability problem.

Second, the extant research on BDA, corporate accountability and NFD is characterised by a limited amount of quantitative empirical work and the lack of theory-driven papers. The former finding can be explained by the limited availability of information about corporate use of BDA and the lack of established measures of BDA effectiveness in corporate settings. As regards the latter finding, most of the papers do not test the existing theory but rather explore new, data-driven phenomena without having a theory in mind *ex ante* and/or make an attempt to build theory from observations. Therefore, the issues

investigated in the present paper are not adequately captured by the existing theories and frameworks at the moment. While applying hypothesis-driven research is complicated in the absence of “sufficient theory”, using a “theory-free” mindset risks to produce results without meaningful insights (Faghmous and Kumar, 2014, p. 161). Instead, among the sampled papers that rely on theory (35%), two major categories can be distinguished. On the one hand, some papers (15%) rely on a few established accounting and management theories, such as stakeholder theory, dynamic capability view, resource-based view and actor-network theory. These papers are mostly concerned with how BDA can be implemented to increase corporate sustainability performance. Therefore, at the moment, established theories and approaches have not been adapted to explain how accountability can be enhanced in the BDA era. On the other hand, the remaining theory-based sampled papers rely on the existing theories that originate from adjacent, “non-accounting” fields (e.g. normal accident theory and Bentham’s utility theory). These theoretical frameworks are adapted to explain corporate decision-making and responsibility, relationships between different stakeholders, organisational processes and individual behaviours that are changing as a result of BDA. However, they still represent academic work focusing on BDA in different fields that has been developed separately. Hence, more cross-disciplinary research will foster theory development and enhance scholarly understanding of the relationship between BDA, corporate accountability and NFD.

Third, the results of the paper, as discussed above, highlight some potential ideas for promoting positive change: BDA can enhance the quality of NFD. In particular, such disclosure must not be conceived as a “tick box” approach, but it should become a dialogic tool, also able to increase accountability for environmental and social risks resulting from the use of BDA. As a main consequence, there emerges the need for policy recommendations and ethical standards regarding such a use and its impact. Therefore, the relation between BDA, accountability and NFD represents a fruitful research area, and the present paper outlines five potential themes for future research: new ways in which the technical features of BDA can be exploited to enhance sustainability performance metrics and data-driven NFD; risks and opportunities for smaller-sized companies in accessing and developing BDA capabilities for managing sustainability; stakeholders’ ability to draw managerial attention towards determining “unmeasured” sustainability issues through dialogic NFD; risks and opportunities related to the increased transparency of proprietary “black-box” algorithms; and environmental and social consequences of BDA and their disclosure.

Finally, the study has two major limitations which open possibilities for further research. First, future research will benefit from applying qualitative and quantitative methods for empirically investigating the relationship between BDA, corporate accountability and NFD. Second, future research should consider expanding the scope of inquiry beyond BDA and explore the applicability of machine learning, data mining, textual analysis to NFD.

## Notes

1. Big Data (BD) is a term used to define extremely large data sets that require advanced capabilities for collection, storage and processing, while Big Data Analytics (BDA) refers to the process of extracting useful information from the massive amounts of data using advanced algorithms (Andrew and Baker, 2021).
2. Official website of Elsevier. Retrieved on July 18, 2022. URL: [www.elsevier.com/solutions/scopus/why-choose-scopus](http://www.elsevier.com/solutions/scopus/why-choose-scopus)

- The list of journals was derived from previous literature reviews on the topics of CSR, sustainability and ethics (Andrew and Baker, 2021) and included *Abacus; Accounting and Business Research; Accounting and Finance; Accounting, Auditing and Accountability Journal; Accounting, Organizations and Society; British Accounting Review; Contemporary Accounting Research; Critical Perspectives on Accounting; The European Accounting Review; Journal of Accounting and Economics; Journal of Accounting Research; Journal of Management Accounting Research; Management Accounting Research; The Accounting Review; Business and Society; Business Ethics Quarterly*; and *Journal of Business Ethics*.

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