Corporate Attitudes towards Big Data and Its Impact on Performance Management: A Qualitative Study

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Abstract: This paper investigates the organizational challenges raised by Big Data and its impact on the business environment with a focus on performance management. We investigate managers' perceptions, understanding, and attitudes relating to Big Data and its analytics, in terms of opportunities, extent, limitations, challenges, and implications, with specific reference to performance management. The research methodology we adopt is grounded theory: we develop a reflection guide based on research questions covering the impact and challenges of a data-driven culture on business, and the impact on performance management and the decision-making process. The results obtained from senior executives from 21 Romanian companies leads to a conceptual model that distils the major areas arising from the responses and the interrelationships between them. These reveal several key areas of managerial relevance and suggest fruitful action. In particular, we find that the most critical areas requiring intervention lie in the area of awareness and understanding, goal setting, assessing benefits and limitations, learning to trust data, and commitment to an embedded data-driven culture. In addition to changes within organizations themselves, there are also implications for other stakeholders, such as education providers.

1. Introduction

Big data and its big analytics (BD&BA) are the new basis on which organizations must build their business strategies in order to survive in an increasingly quantified world. This increasing rise in the importance and challenges of Big Data (BD) is considered to be "one of the most important features of the contemporary economy and society" [1].

The BD revolution is challenging and will continue to challenge the business landscape. According to a recent survey targeting 60 Fortune 1000 and other leading companies in the USA, "84% of enterprises have launched advanced analytics and Big Data initiatives to bring greater accuracy and accelerate their decision-making," and over a third of these enterprises say the area is their top priority for advanced analytics and BD investment [2]. BD applications and analytics are projected to grow from US$5.3B in 2018 to US$19.4B in 2026 worldwide [3]. Businesses using BD will see US$430 billion in productivity benefits over their competition (not using such data) by 2020, according to the International Institute for Analytics [4].

Despite its acknowledged role as a potential source of value for all businesses, BD remains a fashionable but not well understood or fully clarified concept [5]. This raises multiple challenges for organizations. Alongside important technological challenges, the need for cultural change and

leadership commitment is a critical component for success. As one analytics professional has argued, "a lot of what we do early on in the process has almost nothing to do with technology, nothing to do with technology and data, and has everything to do with organizational change and adoption" [6]. Even though survey results show a constantly improving situation, this challenge remains a significant one, so significant that some even consider that the required changes in analytical orientations, strategies, and skills may require a generational change in company leadership [1].

Understanding these challenges is the focus of this paper. The majority of the studies that have investigated the organizational impact of BD have been carried out for U.S. companies. Although these analyses provide interesting and useful information regarding the general dynamics of these transformations, their potential utility in other geographical contexts is limited. In this paper, we explore these issues as they are perceived and addressed by Romanian executives, and we focus on the area of performance management (PM).

Our focus on PM has two main motivations. First, PM is a well-known domain for executives. We therefore position them in a "familiar" context, which is easier for them and more useful for our research objectives. As executives play the pivotal role in implementing a data-driven organizational culture, is important that they are fully committed. Second, the *consistency* between BD and PM is a topic that is currently under investigated. However, the potential benefits of such consistency have been identified by other studies. According to the NewVantage Partners Big Data Executive Survey 2018: "an area of interest will be the shift from the use and deployment of data for traditional reporting applications to near-real time dashboards and real-time interactive operations" [2]. We believe that this domain can significantly benefit from BD-based insights. Moreover, PM systems using business intelligence (BI) technologies have been successfully used as a means for executives to engage comfortably with analytics and data-driven approaches. This could be a disadvantage: according to some data science practitioners, "the unlearning challenge" is one of the most important in implementing a data-driven organizational culture [6]. However, we consider it a solid base to build on.

This paper is a continuation of our previous research, which focused on the impact of information technologies on the approaches organizations take to business performance management [7–9]. More specifically, this paper investigates executives' perceptions relating to these changes in terms of opportunities, extent, limitations, challenges, and implications, as well as on the way that business performance is measured and managed. Further detailed discussion and overview of the concepts and practices of the data-driven organizational model as they have been addressed in the literature is the subject of Section 2.

Our specific research questions and their associated themes and sub-themes are set out in Section 3. We investigate them using the qualitative research methodology of grounded theory. The data we collected are free-text responses from executives to a series of questions in a reflection guide, each question being linked directly to the research questions. Full details of our research methodology are covered in Section 4.

Our choice of methodology is driven by the recognition that established convictions and beliefs still tend to stifle technical progress: the mindset of managers and decision-makers has a crucial impact on what can be achieved. The success or failure of any organizational change imposed by these new information technologies depends, above all, on people's attitudes towards it. It also depends on their knowledge and crucially on their *self-assessment* of that knowledge, distinctions that would not be revealed if we had adopted, say, a traditional Likert-based questionnaire.

Our results are presented in Section 5. We develop a conceptual model based on an analysis of the raw data obtained. This model isolates the main categories that emerge from the data, together with a number of related and overlapping concepts.

The paper ends with our conclusions, comments on the limitations of the current study and directions for further investigation (Section 6). There are, in particular, managerial implications relating to the awareness and understanding of BD and its impact on businesses, and to the alignment between data and the decision maker. We also identify broader implications concerning ethical and social issues that must be addressed.

2. Literature Review

We structure our review of the literature into four subsections. In the first three we provide a survey of the relevant background and the context of our investigation in this paper. This covers, in turn, the areas of PM, BD&BA, and then what has been explored when these are considered together. Our final subsection covers work that is related most directly to our investigation into management perceptions and attitudes towards BD&BA in the area of PM.

2.1. Performance Management

PM is defined as a set of measurement tools and dashboards designed to assess management decisions and to quantify the effectiveness and efficiency of actions taken [5] through acquisition, collation, sorting, analysis, interpretations, and dissemination of appropriate data [10]. Since 1980, many authors consider that PM has become more and more complex due to increases in competitiveness [2]. More structured and unstructured data are becoming available and a variety of inputs are becoming increasingly important for business sustainability. Business performance management represents a set of PM and analytic processes, including business processes, methodologies, metrics, and technologies used to measure, monitor, and manage business performance [11].

Business performance information systems have been used to support decision-making at the strategic level, by balancing various indicators—quantitative and qualitative, lagging and leading—against targeted objectives and industry benchmarks and using different measurement systems (such as balanced scorecards). PM systems generate additional management tools relating to a platform for automated data exchange, monitoring, and analysis. From the 1990s, BI has contributed to the refinement of these systems. Some authors consider that the following characteristics are relevant for effective BI-enabled PM: (a) an integrated, multiple-source, performance system; (b) simultaneous tracking of different business angles and dynamics; (c) enabling a multidimensional analysis of causes and effects; (d) providing relevant, 360 degree, business performance information for cross-functional use; and (e) enhancing the sophistication of the PM system and the consequential impact on business decisions [12].

2.2. Big Data and Big Analytics

The BD era comes with new challenges and opportunities for the business environment, alongside threats and disadvantages. The expectation is that existing PM frameworks need to be reconsidered so that new insights from BD become available. It is not simply a matter of quantity; BD also includes differentiating characteristics such as: "the emergence of the collection and storage of unstructured data primarily from unconventional sources—social media, blogs, sensors, mobile devices, online chats, etc." [13] (p. 51), and the velocity with which the data is produced. Schonberger and Cukier (2013) define the process of "datafication" relating to the new BD world: "To datafy a phenomenon is to put it in quantified format so it can be tabulated and analysed" [14] (p. 78). BD implies more than a quantitative change; it also implies a qualitative change.

Powerful data-driven processes associated with BD that provide insight (analytics), conventionally termed "big analytics" (BA), are developing rapidly. Through these new analytics, "Big Data is transformed into information that provides value by enhancing decision-making capabilities through knowledge generation" [15] (p. 46).

BA, by providing a more meaningful inside view of organizations, are allowing better levels of business performance. "Analytics should be pervasive within an organization. . . . It should be used on an ongoing basis to monitor the performance of the organization and to indicate potential problems" [16] (p.31). This increasing need for more sophisticated information and more effective and quicker decisions force companies to adopt decision-making models based more on business analytics. The "data-driven decision-making approach—DDD" [17] is becoming the new reference paradigm in decision management and most of the organizations are struggling to become data-driven.

The benefits of integrating BD&BA within current organizational models are largely recognized. Chen et al. explore the multidimensional, cross-industry application of BD&BA, leveraging the opportunities arising from the abundant data and their analytics in various areas of interest [18]. One important benefit of using BD&BA is that it creates a competitive advantage for businesses, that would "generate significant financial value across sectors" [19].

Another study conducted in the U.S. tested the hypothesis that data-driven companies are performing better than others. The final conclusion of the study was that: "Data-driven decisions tend to be better decisions. Leaders will either embrace this fact or be replaced by others who do" [20].

A study undertaken in 2016 by Klynveld Peat Marwick Goerdeler (KPMG) analyzed the views of 400 U.S. CEOs uncovered the ways that companies are harnessing BD&BA for their business: improving financial reporting, developing new products, finding new customers, and managing risk [21].

Organizations increasingly recognize the need to create new strategies and digital business models, under the threat from both data-driven, highly agile competitors and digital start-ups. According to the Big Data Executive Survey undertaken by NewVantage Partners in 2018, 79.4% of respondents (in contrast with 46.6% in 2017) acknowledge a threat of disruption and displacement, and the need to adopt new analytically driven behaviors and tactics in their attempt to compete against their agile, data-driven competitors [2].

2.3. Data-Driven Performance Management

In the area of PM, BD provides a range of advantages. These include: decision support, predicative sales forecasting, customer comprehension, and insight into customer-facing operations [20]. Other benefits of integrating BD into PM, include: improving marketing and sales by better understanding the customers, improving budgets and generating more effective decisions, lowering costs, and increasing the contribution of enterprise resource planning (ERP) systems within companies [22].

A white paper [23] considered ways in which BD can align objectives through key performance indicator (KPI) dashboards. This work is intended to motivate the company's own KPI dashboard software solutions, but nevertheless offers useful case studies that illustrate how dashboards can be used to effectively summarize analytics arising from BD in various areas of performance. These include examples such as handling product complaints, customer care (using speech analytics), up-and cross selling (using agent technologies), and monitoring adherence to policy by employees.

The Association of Chartered Certified Accountants (ACCA) has undertaken a useful set of case studies that connect BD with PM [24]. The focus was to explore the applications in retail (Walmart, Tesco), and technology (Beredynamic) concerning issues such as improved marketing, better forecasting, automation of business processes, and performance measurement. In all cases, there are demonstrable improvements in brand awareness, cost reduction, and revenue growth.

Another study dismisses the preconception that the application of BD would mainly favor retailers, multinational companies or big banks; large amounts of structured and unstructured data are provided throughout social media by all companies, regardless of their size. This is widening the perspective of PM in the BD era, by creating a matrix capable of measuring the multidimensional competitive business environment [19].

The NewVantage Partners' Big Data Executive Survey 2018 identified the movement in the direction of real-time reporting and applications as being one of the major technology developments that will shape the direction of data management and data innovation in the coming years. A significant part of the executives interviewed (47.8%) replied that "data was being used for near real-time, intra-day dashboards and operational reporting, or for real-time, interactive, or streaming customer-facing or mission-critical applications" [2].

2.4. Executives' Attitudes and Perceptions

Current research concerning the implications of BD&BA in PM is still in its infancy, and relevant literature and research is currently rather limited. However, the business literature highlights the

pivotal role of change management for BA. A positive correlation between decision-makers' capacity to understand the business context and their ability to change has been shown [25].

McAfee and Brynjolfsson identify the main management challenges that relate to the transition to a data-driven organizational model: leadership, talent management, technology, decision making, and company culture [20]. Only one of these challenges is related to the technological aspects, all others relate to human and organizational issues. Zurbino et al. claim that a Big Data-oriented change management program should be consistent with the ADKAR (awareness, desire, knowledge and ability, reinforcement) framework for change management and details each dimension of it for people involved in a BD-enabled CRM (customer relationship management) [10]. According to Tamba becoming a data-driven organization "often requires organization-wide changes to complement data-driven technologies" [5].

Increasingly, executives realize that the greatest barriers to creating data-driven organizations and building data culture within their firms are not coming from the technology, but from issues relating to people and change. Almost half (48.5%) of the U.S. executives surveyed in 2018 identify people challenges as the greatest barrier to becoming data-driven, while only 19,1% of them cite technology as the issue. "People challenges loom greatest as firms strive to create data culture" is listed as one of the key findings of this study [2].

Despite the growing interest in BD&BA and their potential value for businesses, there are no best practices to organize an analytics operating model. Recent McKinsey research has found little correlation between how analytics is organized and how successful it is. The consistency of the operating model with the business model is more important, so that "it can take advantage of the successful elements of the existing culture and practices while still promoting the cross-functional practices that any analytics effort needs to succeed" [11].

From the management perspective, the main issue lies in understanding the potential value of the insight that is provided by BD&BA and convincing the organization to change the way it does business. According to Schmarzo, two of the main challenges to making analytics work are the *inspiration challenge* and the *unlearning challenge*, both addressing the executives' role in this process. An executive cannot mandate change, they need to "inspire people so that they learn and feel like they internalize it" [26]. Moreover, senior executives must struggle to unlearn routine assumptions (concerning, ERP projects, data warehousing, building dashboards, etc.) and to step out of their comfort zone in order to take advantage of the new BD&BA world they need to face.

Both the scientific and business literatures largely recognize that the shift to a data-driven organizational culture falls primarily on managers and executives. Furthermore, most organizations still lack strong leadership regarding topics relating to data and analytics, and even if the situation is constantly improving, there are still not enough leaders committed to manage their businesses and compete on this basis. According to the one of the latest survey of executives on this topic, though 98.6% of executives consider that their firms are in the process of creating this new type of corporate culture, only 32.4% were reporting success on this front [2].

The literature also highlights the need for new management skills in order to design and implement new strategies and analytical business models. A McKinsey Global Institute study estimates that there will be a shortage of 1.5 million managers and analysts with the skills to make decisions based on the results on analytics [27]. Furthermore, according to Davenport, these changes in skills, strategies, and analytical orientations may require "a generational change in company leadership" [1]. Schmarzo considers that Analytics should be a business discipline and that universities should prepare students to become "citizens of data science" [26].

Another investigation into the use of BD that, like ours, took place within a single national context, took place in Brazil [28]. This was restricted to a case study involving a single multinational company. As in our own research, a qualitative approach was employed involving, in this case, a small number of interviews. The results showed that applications of BD have led to enriched performance measurement analysis, both prescriptive and predictive. The former provided greater in-depth clustering analyses while the latter allowed the creation of new strategies in the areas of sales.

The data-driven paradigm needs, more than anything else, a major shift in attitudes, as novel analytically based insights identify opportunities to do things differently. "Rather than making decisions based on experience, people need to be convinced to trust data as well as informed recommendations" [29] (p. 7). Analytics professionals claim that BD&BA will not replace intuition and human empathy factors but will help people make better decisions [26]. However, executives' confidence in the numerical evidence remains lower than would be expected by their level of commitment to a data-driven organizational culture. According to a survey conducted by KPMG in 2016, 70% of the executives believe that by using data and analytics, they expose their organizations to reputational risk [21].

The use of BD&BA in organizations remains an under-investigated topic, both in the research and business literature. While researchers debate the robustness of the concepts and the possible implications for different business frameworks and managerial models, organizations—challenged by agile data-driven competitors—find themselves at different stages: from understanding and making sense of the business opportunities offered by these new technologies to struggling to integrate them within their business models.

3. Research Framework

Our research focuses on the attitudes of executives towards the data-driven organizational model and its particularities in the area of business PM. It aims to provide an assessment of the current situation—in terms of awareness, expected benefits, challenges, and achievements—and to determine the most likely approaches for establishing an appropriate data-driven culture within the organization.

With this in mind, we have developed three (generalized) research questions. Our future ambition, discussed in more detail in our conclusions (see Section 6, below), is to address a broader range of issues in relation to BD&BA than is covered here. As a consequence, these generalized research questions may be reused, offering some future benefit regarding comparisons across different areas of focus.

For present purposes, these questions are refined first by a set of themes to be investigated and then a number of sub-themes (Table 1). This overall structure of topics to be investigated, i.e., our research framework, provides our focus on PM and its BD&BA context.

The general research questions explored are:

- Research Question 1 (RQ1): *What is the current state of awareness and deployment of BD&BA and of their impact on businesses*?
- Research Question 2 (RQ2): *What are the main challenges raised by BD&BA and how are these to be addressed within businesses*?
- Research Question 3 (RQ3): *What are managers' attitudes towards data in the decision-making process*?

Table 1. Topics investigated and their relation to the research question.

Research Question	Theme	Sub-Theme	Reflection Guide Questions
RQ1	The business impact of BD&BA	Opportunities	1
		Benefits	
	The data-driven organization	Concepts and achievements	2
		Performance management	5
RQ2	Addressing the challenges of BD&BA	Limiting factors	3
		Plans for action	4
RQ2 RQ3	Impact on Performance Management	Performance management framework	6
		Business reporting	7
	Data in the decision-making process	Trusting data	8
		Data alignment	

Note: Table 1 also maps the research framework to the eight questions that form our research instrument: the reflection guide. This is now discussed in the context of our research methodology.

4. Research Methodology

Since our topic belongs to the general field of human behavior and concerns social processes and their meanings, qualitative research methods are most appropriate for our endeavor. Such studies are conducted with a view to understanding the way in which participants perceive situations and events, and where the meanings they attach to relevant phenomena are of critical importance [30]. This fully aligns with our research questions, which focus on perceptions of and reflections on BD&BA and PM in respondents' organizations. Such methods are also characterized by direct involvement, in which researchers are themselves embedded within the phenomenology of the research topic, in a way that other research approaches do not entail [31]. In particular, as subject experts, we have to *interpret* the data against our own knowledge of the topic, as informed, for example, by the background and related work to be found in our review of the literature (Section 2). As the objective of this article concerns BD&BA and PM in Romanian organizations, our own knowledge of the national context, the relevant business culture, and the theoretical principles underlying the technologies, are also all critical to the success of our approach.

4.1. Grounded Theory

More specifically, we have adopted a grounded theory (GT) strategy as a research methodology [32]. This approach involves the methodical collection of data and inductive theory building [33]. Our research framework (Table 1, above) acts as a formal guide to structure the research instrument (the reflection guide, Appendix A), ensuring that our data collection is, indeed, methodical. Our approach to data collection itself is to elicit facts, attitudes, and perceptions regarding current and future practices in the area under investigation.

Participants were asked to respond freely to a series of open questions, designed to be appropriate for the roles they hold within their businesses. These questions encourage detailed responses, providing factual information, as well as opinions and perceptions relating to their own and their companies' general attitudes and perspectives [34]. We developed the reflection guide based on these considerations, aiming to capture respondents' awareness and experiences of business management in connection with BD, business processes, and PM, in a way that shares features with unstructured interviews. The raw data is, therefore, entirely composed of free-text narrative responses.

The GT methodology develops theory inductively, specifically through processes of classification and category development; it is fundamentally a synthetic approach. The classifications and categories emerging from our research are detailed in Section 4 and its subsections, covering perceptions and attitudes towards impact, benefits, achievements, limiting factors, planning, and reporting regarding PM, and the business more generally, in the context of BD&BA.

Theory building of this kind is context-dependent both in space and time. As with much qualitative social science research, what is true and useful in one milieu and at one point in time will change. This is what makes GT a particularly suitable approach for our current research: the value of our conclusions (the managerial contribution) depends on the currency and relevance of our categorial synthesis (the theoretical analysis).

4.2. The Reflection Guide

The reflection guide consists of four parts. The first two questions explore the respondents' positions on the meaning and importance of BD&BA in the business context. The next two questions investigate the respondents' opinions concerning the challenges of becoming a data-driven organization and ways of addressing these. The questions that follow examine respondents' perceptions relating to data-driven PM (relevance, expectations, and implications). The last question aims to reveal respondents' attitudes toward the balance between data and knowledge in the new data-driven paradigm. The reflection guide appears as Appendix A, below.

The target population consists of executives, with minimum five years of business experience in a variety of industries. They were selected based on their managerial position and their familiarity with the topic under investigation using both theoretical and convenience sampling [35]. In total we collected detailed responses from 21 respondents, each from a different company.

4.3. Methodological Considerations

Qualitative research is inevitably influenced by the researchers' identities. Researchers are as involved in the area under investigation as are their research participants—they have their own opinions, interpretations, and conceptual alignments [36]. In this case, the connection between researcher and participant was especially close, as all respondents had been MBA students on one of two MBA programs: at the National Institute of Economic Development (INDE) or the Romanian–Canadian MBA. Both are delivered by the Bucharest Academic for Economic Studies and two of the authors teach on these programs.

This connection between researcher and participant involved both opportunities and challenges. Our earlier interactions with respondents gave us prior access to informal accounts that we used in order to triangulate the data obtained from the formal responses. In contrast, we had to adopt an objective approach to the data analysis of the formal responses.

Given the current relatively low uptake and understanding of BD&BA in the broader business community, a focus on those who, in this case through their advanced studies, had at least exposure to the theoretical basis of the topic, was essential. In our earlier work [37], we had initially sought to address a broader constituency of managers who had not necessarily any prior knowledge of the research topic. Though willing participants, their lack of understanding overwhelmed their ability to contribute positively to the concepts explored in the reflection guide. This present lack of sophistication among the broader range of Romanian organizations led, in the work reported here in this paper, to a focus on those who could reliably be expected to provide meaningful responses, despite the challenges discussed above.

For this investigation, we have adopted appropriate ethical standards. Specifically, the anonymity of the respondents was ensured, and the data was collected through the Internet. There was no pressure or incentive to complete the reflection guide. In particular, in view of the relationship between the investigators and the participants, the research was conducted some months after participants had been finally assessed at the end of their MBA studies.

5. Results and Discussion

In line with our GT research methodology, our results focus on the synthesis of a conceptual model based on the raw data obtained from the survey. In total we collected detailed responses from 21 respondents. As a consequence, we organize this section in alignment with our research framework: each of five subsections corresponds to the five major themes under the general research questions, and each sub-subsection corresponding to the various sub-themes that appear under those themes. The data that informs the discussions and synthesis is taken from the responses to the relevant questions, as set out in Table 1. A final subsection discusses the model that emerges.

The approach to data analysis is quite standard for GT: identified repetitions in that arise within the data are tagged and re-reviewed as more data and more data is evaluated. These tags (finally called "concepts") are then grouped into "categories," using the standard terminology from GT. The full details of this fine-grained tagging and the grouping that leads to the classifications described below, is of course not provided in full detail. However, the concepts and categories that emerge are motivated with typical and illustrative example responses. These are indicated as quotes, in italics. Responses have been included verbatim. The first language of the majority of the respondents was not English and errors of spelling and grammar have been preserved. The categories and concepts were written in Courier font, with categories indicated with a leading prefix: `C-Category` versus,

simply, `Concept`. In order to avoid ambiguity, concepts are often accompanied by their categories: `C-Category: Concept`.

At the end of each of the various subsections and sub-sections that follow, the emerging conceptual model is provided. The concepts are associated with brief motivating comments based on the full analysis of the data collected but expressed in a way that clearly links to the example comments we have provided in the each preceding narrative.

5.1. The Business Impact of Big Data and Big Analytics

In exploring this, our focus is on determining the opportunities and benefits that respondents identify, and isolating the key perceptions, attitudes and approaches towards them. This we cover in the following two sub-subsections.

First, however, we need to consider *awareness* (the category, `C-Awareness`) and the modes by which this comes about.

The responses show that executives are aware of these technologies, the most common source of information being "*self-learning*". Different channels of communication in the business space, like "*participating at specialized conferences, by being contacted by the specialized companies, by receiving peers' recommendations*" were also information sources for this subject. It is interesting to note among these the presence of companies that sell IT solutions based on BD&BA.

In some cases, they benefit from "*the intensive research conducted by those in the company who share their knowledge.*" Only one of the respondents declared that "*[m]y first contact with this subject was on the Management Information Systems* [MIS] *course in the first year of the MBA.*"

Generally, BD together with artificial intelligence are acknowledged as being new " . . . *trendy*" subjects when it comes to technologies. As one of the respondents noticed "*It is quite difficult today not to become aware of it. Everyone talks of Big Data*".

Overall, `C-Awareness` (Table 2) can be decomposed into active and passive components, both of which involving self-, other-, and company-directed approaches involving study, training, and education, with active approach dominating. Indeed, responses indicate an authentic interest in the subject: almost all the respondents specifically asked us to share the results of this research with them, with requests appearing among direct responses to our formal questions. This is something that augers very well for the management implications of our results, as we discuss in the conclusions (Section 6, below).

In addition, as discussed also in Section 5.1.1 (`C-Approach: Passive`) and Section 5.1.2 (C-Impact: Passive), below, there is plenty of evidence that the Passive component includes a clear *lack* of awareness that is leading to faulty decision making elsewhere.

Table 2. BD&BA—Awarness.

C-Awareness	
`Active`	Individuals, peers, and companies that are mostly taking direct action to raise awareness, through study, training, and education.
`Passive`	Individuals, peers, and companies are being directed; are otherwise externally motivated; or are failing to develop awareness through study, training, and education.

5.1.1. Opportunities

A very clear category `C-Impact` emerges from the responses (Table 3), indicating that business opportunities relating to BD&BA are acknowledged at the executive level of the organization. Two main components arise in this regard: the need to make sense of the complex unstructured data (`Analysis`) and the need to build on predictive and prescriptive mechanisms (`Synthesis`). For example, one respondent claims that "*Big Data and Business Intelligence became important as soon as the number of customers grew and the need for understanding complex structured/unstructured data appeared,*" while

another one highlighted the *"need to understand the nature of different processes within the organization and trying to build on predictive mechanisms."*

Other respondents do not see BD as an opportunity for their business. As expected, they represent traditional companies, that do not generate unstructured digital content in the normal course of their business and for which BD remains of unproven value. One position states: *"We are not an Internet-based company and the scope of business is not big. For these reasons we don't use Big Data or Business Analytics."* Executives of this group would need to have a concrete idea of how BD and its powerful analytics would actually help them in their specific business before considering these technologies as part of their IT infrastructure. What is much less clear from this and similar responses is whether such self-assessments are based on an adequate understanding of the potential and relevance of BD; indeed, it seems that such responses betray a lack of awareness (see `C-Awareness:Passive`, above, and, `C-Approach:Passive` and `C-Trust:Passive`, below).

There are also IT companies (or IT departments within companies) that are trying to push these new technologies systematically (`Active`). As one of the respondents stated, *"My company is a leader in the Analytics and Big Data space, so we are heavily involved in educating the market on the proper use of Big Data technologies."* This contrasts with those who are equally committed but are essentially consumers of new approaches

There is a lot of enthusiasm, and associated promises relating to BD in the technical field (software vendors, big consulting firms, analyst firms). This excitement around BD, coupled with the fact that innovations in information technologies lately seem to play a predominant role in IT–business relationships, make it hard for business professionals to recognize their real opportunities, understand the risks, and formulate rational strategies. Executives should be able to explain very specifically why BD is an opportunity for their business. If they cannot do that, the expectations relating to it are unrealistic. Some responses indicate managers' responsiveness to the promises of these new technologies. According to one of our respondents: *"The technical management is a big fan of Big Data and Business Analytics and we are promoting this throughout our company."*

Table 3. BD&BA—Business Impact.

C-Impact	
Analysis	Interpretation of unstructured data.
Synthesis	Development of prescriptive and predictive models.
Active	Mission to develop impact at the inter-organization level.
Passive	A genuine lack of awareness of impact, leading to potentially flawed assessments and decision making.

5.1.2. Benefits

Some responses indicate that executives perceive BD&BA as a clear source of potential business improvement. They consider that BD might be valuable, but only to the extent that it can be aligned with the existing BI infrastructure. The main benefits identified are: new insights related to the customers' behavior and expectations, reduced costs, ability to predict the future, increased revenues, etc. These lie, essentially, within the components of that were introduced in Section 5.1.1 (see `C-Impact:Analysis` and `C-Impact:Synthesis`, above).

Those respondents that did not see BD as an opportunity for their business do not consider it as a potential source of information that might be useful for analytical purposes aimed at improving business performance (`Reactive`). Again, as discussed in the introduction to this subsection and in Section 5.1.1, above, there is some evidence that this is not based on a mature understanding of the area (see also `C-Awareness:Passive`, and `C-Impact:Passive`, above).

Some respondents tended to overestimate the benefits that BD&BA would bring to their business. This "hype" group was represented by executives of IT companies that tend to worship new technologies and use visionary language to express their potential benefits. As one of respondents

says: "*Agile business, intelligent decisions, customer intimacy are only some of the benefits of Big Data*"—a statement that contains all the "right" keywords.

We found that, in general, there are three types of approaches (category `C-Approach`, Table 4) relating to the business impact of BD&BA:

- The "interested group" (`Interested`): Executives that consider BD an important business opportunity, appreciating mostly its potential to reveal useful information from complex unstructured data and to build predictive insight. They usually see BD as an extension of the company's BI infrastructure.
- The "skeptical group" (`Skeptical`): Executives, representing mostly traditional companies, that do not value the potential benefits of BD. They need to sort through what is overrated and what is real for their specific business contexts relating to BD. This problem appears in several responses: "*The company is starting to be more aware, but we still must put a dollar value on our Big Data and Business Analytics eventual efforts*" and "*One of the main stoppers in my activity was not clearly seeing the benefits vs the invested budgets*".
- The "enthusiastic group" (`Enthusiastic`): Executives of IT companies that are trying to "push" BD&BA on the market and to convince businesses of its value.

Table 4. BD&BA—Approach.

C-Approach	
Interested	Executives viewing BD&BA as a business opportunity.
Skeptical	Executives that (genuinely) do not see any potential benefits of BD&BA.
Enthusiastic	Executives that are manifestly pushing BD&BA
Passive	Executives that fail to appreciate the potential benefits of BD&BA due to a lack of awareness.

5.2. The Data-Driven Approach

Our main aim here is to gauge the opinion of executives regarding the data-driven organizational model and to assess the current degree of penetration of datafication within their businesses. The analysis further addresses the area of PM.

5.2.1. Concepts and Achievements

The responses suggest that, unlike BD, the data-driven organizational model concept was not fully acknowledged at the organizational level. Some responses identified their current information systems, that address structured collections of data or information, as "data-driven". As one of respondents answered "*Management (at all levels) takes decisions based on reports. The reports are data driven. So, I would describe my company as already being a data-driven organization*". This is not surprising, as business analytics and data-driven approaches are currently used in organizations' management support systems. These "classical" data-driven approaches are generally perceived in the business world as business intelligence systems or initiatives. However, the term "data-driven decision making" and the term "data-driven organizational model" are concepts that have emerged in relation with BD phenomenon (`Passive`).

Almost all of the respondents (mainly relating to `C-Approach:Interested` and `C-Approach:Skeptical`) agree that their organization is not data-driven and that there are no strategies in place to address this issue. One of the responses sums this up well: "*For the time being, there is no open discussion on the top management agenda for the mentioned topic—it's not applicable yet.*"

However, some executives consider their organizations—or at least the majority of their business models—as being "data-driven." As one respondent declared: "*Our company is using Big Data analysis on almost every type of business decision you can think of – marketing campaigns, product selection, financial analysis, supplier purchasing, warehouse management, just in time inventory, online analytics, etc.*" Their

answers suggest that they are interested in moving towards a data-driven organizational model, but there are no clear "guidelines" or "best practices" that they can refer to regarding this mission. "*In the beginning, we try to extend our digital influence in every level of the organization, and to make every online business as automated as it can be*" (`Enthusiastic`).

These answers are not surprising; decision making based on BD&BA is still in its infancy and there are no conventional frameworks for analytics projects or BA initiatives. Although acknowledging the need to implement a data–driven organizational model, companies are still waiting for a more feasible and more widely accepted solution. However, from the management perspective, the main issue lies in its attitude through understanding the value of insight and convincing the organization to change accordingly. It is, therefore, important to note that even those executives that recognize the benefits of BD&BA at a declarative level, position themselves rather passively towards it.

These observations all fall under the category `C-Approach` (Table 5) and we provide an updated model to that given in Section 5.1.2.

Table 5. Approach—data-driven organizational model.

`C-Approach`	
`Interested`	Executives viewing BD&BA as a business opportunity.
	Executives are hampered in the absence of best practices.
`Skeptical`	Executives (genuinely) do not see any potential benefits of BD&BA.
	Executives remain unconvinced pending emergence of best practices.
`Enthusiastic`	Executives that are manifestly pushing BD&BA.
`Passive`	Executives that fail to appreciate the potential benefits of BD&BA due to a lack of awareness.
	Executives misinterpret current BI practices as exemplars.

5.2.2. Performance Management

We investigated executive attitudes towards adding BD&BA as an extension to the current PM framework based on BI technologies—the business management performance system.

As expected, the answers were more detailed than those associated with the commitment to a data-driven organizational model. PM is one of the most important business models to which executives relate. Moreover, even the responses of managers aligning with `C-Approach:Skeptical` suggest that they understand and value the benefits of using BD&BA in PM, especially those related to real-time analysis and proactivity. As one of respondents answered: "*Big Data is meant to supply prompt and reliable responses, impact prediction and feedback over general business performance.*" The main benefit of using BD&BA is related to the emphasis on predictability in the context of the multidimensional performance analysis carried out in the current PM systems.

The need to extend existing PM systems with BD&BA components is a "leitmotif" that appears in many responses: "*What Big Data brings on top is an ability to do predictive analytics—What will happen—and prescriptive analytics—How can we make it happen. This is done by adding external data sources like social media data, analyst reports, demographic data . . . and combining it with powerful machine learning algorithms*" (Active and Synthesis) and "*Big Data and Big Data Analytics are starting to be used to fuel business intelligence technologies. Most of the reports produced by BI rely on 'dead' data. This means historical, past data (even if past means just one day or one hour ago). The next step would be to move to predictive BI where the algorithms would suggest different potential courses of actions to be taken by management, each with particular benefits and calculated chances of success. And you cannot have this without Big Data Analytics.*" (`Focus`)

It is interesting to note that all respondents clearly identified the benefits of using BD&BA in PM. Moreover, they consider the extension of the existing PM systems with BD&BA to be a natural and feasible way to enhance the analytic power of the PM model. They have a vision and also a clear and practical approach when the discussions relating to the notion of being data-driven move from the

organizational level to the PM area. This is, in our opinion, a very important aspect. As discussed earlier in this paper, the success of any BD&BA initiative depends primarily on leadership commitment. Therefore, is crucial that executives experience the benefits that these technologies bring in the context of activities and business processes that they master directly.

These considerations lie squarely under the category `C-Impact` and we provide an updated model to that given in Section 5.1.1 (Table 6).

Table 6. BD&BA—Impact on PM.

C-Impact	
Analysis	Interpretation of unstructured data, specifically to inform performance management.
Synthesis	Development of prescriptive and predictive models.
Focus	Consequences of specific approach focusing on performance management.
Active	Mission to develop impact at the inter-organizational level.
Passive	A genuine lack of awareness of impact, leading to potentially flawed assessments and decision making.

A reasonable conclusion is that the area of PM can be considered as one of the first areas in which BD&BA can be successfully implemented. This is mainly supported by two judgements. First, PM is an area well-known by executives and they are eager to benefit from all the new and valuable insights promised by these new technologies in their current activities relating to PM. Second, from a technical point of view, BD&BA can be integrated with, or added to, the existing PM framework, whose infrastructure is based on BI.

5.3. Addressing the Challenges of Big Data and Big Analytics

Under this theme we investigated both the main challenges raised by BD&BA and ways of addressing these challenges from a managerial perspective.

5.3.1. Limiting Factors

BD raises new and varied challenges for businesses. In order to address them, organizations should clearly identify and analyze all these challenges and prioritize them.

We were, therefore, interested to see which factors executives perceive as being the most restrictive for a successful translation to a data-driven organizational model.

The main barriers (`C-Limits`, Table 7) to BD&BA were revealed from a large number of the responses:

- Business strategy focus and inertia (`Focus`)

  "*No vision to elaborate a strategic view*"

  "*Business understanding of subject and commitment*"

  "*Organisations are too slow to respond to the changing environment*"

  "*Reluctance attitude to effort and innovation*"

- Lack of skills (`Skills`)

  "*This new field of Big Data requires skills that are lacking on the labour market. Those who really have the advanced skills are very expensive.*

  "*The lack of required skills to process the data effectively is by far the biggest limiting factor we are facing at the moment*"

The data itself is considered to be another challenge. Some of the respondents raised the issue of "data quality." However, this aspect is relevant in a "small" data world. BD can be ambiguous and imprecise as its volume swamps these inaccuracies and does not jeopardies the value of the insight.

Another interesting observation arises from the following response: "*In the current technological era access to data is easier than ever, but the difficulty comes from knowing what kind of data to look for and where. So disseminating the real data from the noise can be a lengthy and resource intensive process without proper knowledge and tools.*" This is a well-made point, as in a BD world, one major challenge is to address the right data.

Other identified limiting factors were related to data privacy (`Privacy`), in terms of "*GDPR or customer privacy needs*" and cost.

Almost all the responses suggest that the main challenges relate to management vision and a lack of competencies. There is a clear tendency to identify a lack of skills as the most important restricting factor for implementing BD&BA. This is to be expected, as it is generally acknowledged that the professionals that are needed for BD&BA are not easy to find and, if available, extremely expensive. In addition to technical competence, these professionals (called data scientists) also need to be sufficiently familiar with the specific features of their organizations in order to deliver maximum value to the executive.

Table 7. Data driven organizational model—Limiting factors.

C-Limits	
Focus	Failure of vision, commitment, agility, and attitude.
Skills	Lack of appropriate human resource: technical and business oriented.
Privacy	Issues concerning BD&BA and, e.g., the General Data Protection Regulation.

5.3.2. Plans for Action

The responses here (`C-Action`, Table 8) indicate that executives are indeed willing to address the previously identified challenges.

The vision of the respondents regarding the data-driven strategy can be summed up in the following actions:

- Setting the right expectations from the beginning (`Proactive`)

  "*defining the business problem that the Big Data project is trying to solve*"

  "*be aware of the benefits and limitations of BD&BA*"
- Hire Big Data specialists (`Skills`)

  "*we would partner with Universities in order to attract graduates (Master students preferably) directly from the university*"
- Training activities (`Active`)
- Change management activities (`Focus`)

  "*convincing the employees to change the way they operate*"
- "*inviting Big Data companies to convince the company management of its positive impact*"

  "*understand that we need to change the way we are doing business*"
- Investing in the right technologies (`Focus`).

  "*People/companies are many times tempted to choose the 'Do it yourself' approach thinking it will be cheaper and that no standard technology on the market can meet their specific business requirements. This leads to a high abandon rate or a higher time & effort to implement the respective project (which offsets the initial cost gain).*"

It is interesting to note that more respondents identified the leverage role of change management for implementing a data-driven organizational model, even when this option was included in the

question itself. As the respondents are senior executives, this commitment (`Active`), at least in their responses, to engage in change management activities is a significant result.

Another interesting observation is based on the response: "*Hiring data scientists is nowadays the trendy thing to do.... But there are some other elements that will dictate whether a company will succeed or fail in improving the business results through the use of Big Data, one of them being the presence of citizen data scientists in the company – those people that have domain knowledge, are highly analytical and curious, are not afraid to challenge assumptions, know the right questions to ask, understand the data, are not afraid to learn and to fail. They are the ones bridging the gap between business functions and the technology department. So having a team of data scientists sitting in an ivory tower will show marginal and late impact on the business in the absence of the citizen data scientists, which, of course, requires training as well as a change in the organizational design.*" This is a well-made point which relates to the intellectual *social* climate (`Social`): having the right mix of (properly trained) technical and business staff. After all, a solid partnership between business users, analysts and IT professionals is an essential precondition for the success of any project that involves technological change. In contrast, however, none of the responses indicated the necessity to hire data translators or to create a chief data officer function. This shows either a lack of focus and commitment in addressing the identified challenges or, perhaps more likely, a persisting failure of understanding (`Skills` and `Passive`).

Table 8. Data-driven organizational model—Plans for Action.

C-Action	
Active	Setting appropriate expectations.
	Committing to necessary change management.
Focus	Well informed investment strategies.
	Pressure to commit to necessary change management.
Skills	Adopting a strategic approach for hiring appropriate staff.
	Failure to anticipate full range and level of skills sets required.
Social	Ensuring appropriate mix and balance of BD&BA-trained IT and business professionals.
Passive	Lack of action arising from a failure to develop complete awareness of BD&BA.

5.4. Impact on Performance Management

This research theme assesses the impact of BD&BA on PA and its development.

5.4.1. Performance Management Framework

We were able to classify the responses into two major categories: A normative category (`CP-M-Normative`, Table 9), that focuses on how BD&BA should change PM systems; and a descriptive category (`C-PM-Descriptive`, Table 10) that anticipates the expected impact.

Within in the normative category, we identified three main themes within the responses. The respondents noted:

- The active role that BD&BA should play. For example, noting: "*the evolution from descriptive to prescriptive analytics in PM*" (`Integration`).
- A recognition of the need for increasing predictability that would help companies better cope with the on-going changes of the business environment and would increase business awareness. As one respondent claimed: "*The most important impact on BPM is that of predictability and becoming more aware of the changes in the market and the flexibility to make the needed changes in the company*" (`Performance`).
- The role of BD&BA as drivers for enhancing the consistency and accuracy of PM KPIs and for better understanding the causes of various changes. As one respondent stated: "*It can definitely do it by*

increasing the consistency and accuracy of the KPIs and speeding up the understanding of the cause for certain changes in KPIs" (`Performance`).

- A focus on the need for a more efficient and flexible PM system that will contribute to a broader business perspective, without specifying what this means or implies: "*Implementing BD and BA in a company can relieve the business opportunities, improving areas needed and more efficiency, swiftness and flexibility,*" and "*It would offer a global view and many more perspectives and viewpoints*" (`Development`).

- That BD should be capable of providing any kind of relevant information, if decision-makers actually know what to look for. One respondent's recommendation is to "*change the way performance management reports are designed and then use Big Data to fulfil the needs*" (`Integration`).

It is interesting to note the emphasis that managers place on the active role of the decision maker in this process, in the context of the weakening role of knowledge—when viewed as experience, intuition, and judgement—and the increasing power of data in the decision-making process. Even if data can respond better to our questions, it is still our role to formulate the right questions.

Within the descriptive category (`C-PM-Descriptive`), the respondents await increasing efficiency (`Efficiency`) and timeliness (`Timeliness`) from the decision-making process, the better fulfilment of KPIs, and on-time decisions for on-going challenges. Relevant responses here included:

- "*Drive more efficient decisions, increasingly offer support for customized decisions.*"
- "*Business Analytics will gradually replace repetitive and non-complex tasks and therefore the performance management will be focused on complex areas which usually require significant judgement.*"
- "*Achieving the sales and delivery targets through all kinds of consulting solution will result in the end in a better performance management evaluation. Big Data and BA can play a big role from now on.*"
- "*In our customers companies we believe Big Data and Business Analytics are essential for getting quick info regarding their company performance and take data-driven decisions to stay productive and profitable.*"

There were also some irrelevant opinions for our purposes. For example, one respondent refers to automated decision making: "*But I glimpse a future where more and more business decisions are being automatized and left for the algorithms to handle. One obvious example would be everything related to stock management. Or pricing policies.*" These matters go beyond our current investigation.

We can conclude that the shift from "past-oriented data" to future perspectives and predictions is the major expected value of a data-driven PM system.

Table 9. Impact on PM—Normative dimension.

C-PM-Normative	
Integration	Embedding prescriptive and predictive analytics within the organization's approach to PM.
	Changing the approach to PM to align with the results of BD&BA.
Performance	Improving predictability and awareness of levels and changes in organizational performance.
	Improving the accuracy, relevance and consistency of performance measures.
Development	Utilizing the results of prescriptive and predictive analytics in the area of PM for strategic organizational development.

Table 10. Impact on PM—Descriptive dimension.

C-PM-Descriptive	
Efficiency	Utilizing the results from the approach to PM to better inform decision making.
	Allowing data to directly drive decision making (or at least part of it).
Timeliness	Allowing the approach to PM to increase agility and productivity.

5.4.2. Business reporting

Most of the answers in this area did not provide a specific solution, but rather highlighted the expected features and capabilities of the new reports (`C-PM-Visualization`, Table 11). For example,

one respondent stated that he expects BD&BA to "*improve the objectivity level and reports' quality, allow deep dives and improve the prediction process*" (`Performance`). Other expectations refer to a simplified PM system and to improved predictions: "*They will simplify the process and make it easier to reach to more objective conclusions*" (`Efficiency`), as well as to provide "*an accurate view about the performance of a company*" (`Performance`). According to our respondents, BD&BA might be more helpful if they could become increasingly relevant for the measurement system. Flexibility was again stressed as a desirable characteristic of a future PM framework (`Timeliness`).

One respondent emphasizes, as most important improvement, the ability to simulate future scenarios on-time, which would maximize business capacity in order to reach separate objectives: "*The biggest improvement to them would be the ability to simulate the future based on different scenarios that the user (the consumer of reports) could easily play with. And of course, directly suggest potential courses of action with the aim of maximizing various set objectives (such as short/long term profitability, capture market share, etc.).*" (`Development`).

Another respondent stated that a "*balance scorecard is merely useless in terms of significance if it does not come with tools to indicate quickly why certain performance has changed,*" which indicates an important need for a more complex "*management tool-box,*" as part of the balanced scorecard (`Performance`).

One of the most relevant answers was metaphorical, a comparison with the evolution of car dashboards: "*I would use the analogy with a car—even if you take a car manufactured in the 60s or one from today the dashboard will provide the same basic data (speed, fuel level, engine temperature . . .). Majority of the cars will even have the information displayed in the same way. The difference comes from the hundreds of sensors a car has today and the real time information they provide that allow a safer and more pleasant ride. In some cases, the car will even take action in your behalf—breaking in case of an imminent collision. If we take the analogy back to the business world, the performance management reports give you the current status of your business, while Big Data are the sensors alerting you of the changing conditions.*" Clearly, in order for this analogy to hold, the BD&BA need to be wholly and properly embedded within the organization (`Integration`).

Table 11. Impact on Business reporting—Visualization.

C-PM-Visualization	
Integration	Fully embedding BD&BA within the organization in order to drive visualization and reporting more generally.
Performance	Development of appropriate analytic tools to drive performance reporting.
	Improving the accuracy of BD&BA-informed reporting.
	More detailed reporting through deeper BD&BA analyses.
Development	Using BD&BA for scenario planning to inform strategic organizational development.
Efficiency	Improved BD&BA-driven reporting.
Timeliness	Development of rapid and flexible reporting.

BD&BA will impact business reporting through its capability to better simulate future scenarios. This will enable the entity to simultaneously engage in separate actions (objectives) in a more effective way. It will shift focus from an analysis of the past to proposals for future data-driven scenarios, allowing the multidimensional analysis to be used cross-functionally. The model indicates that there is generally good awareness of the ways in which reporting will be and should be valuably improved.

5.5. Data in the Decision-Making Process

It is generally considered that in a BD world, data offer insights that should not be doubted. However, knowledge is required to make sense of the solutions provided by BA to address the right data and also to define the conceptual need for the analytics themselves.

Our interest was to examine the attitudes of managers towards the balance between data, knowledge, and decision making, in the new data-driven paradigm.

Our analysis, set out in detail below, indicates that *trust*, whether considered directly (Section 5.5.1) or indirectly through the alignment between data and intuition (or experience), is the fundamental category (`C-Trust`, Table 12).

5.5.1. Trusting Data

The majority of the respondents were aware of the essential role of data for their informational needs in the decision-making process. However, there is also a general tendency to question data quality and accuracy. This suspicion regarding the available data was related to the quality of data stored in their existing information systems.

Generally, managers recognized the active role people play in effectively making sense of data. As one respondent answered, "*Data is giving you as much information as you are able to ask from it so it is vital that you know your domain and you fully understand the data you are analyzing, otherwise you might end up taking the wrong decisions.*"

There were also respondents who do not consider data to be important—as one of them answered "*Data is history. History is not the best way to predict the future.*" It is interesting to note that this answer is not related to BD, which is real-time, streaming data, but with historical data available in different storage structures within the organization.

Others did not trust evidence in the decision-making process. As one respondent answered: "*I treat the evidence with scepticism.*"

All these responses are a stark indication of a significant weakness in understanding the nature and implications of BD&BA (`Passive`).

5.5.2. Data Alignment

One of the more critical aspects of BD is its impact on decision making, and who gets to make these decisions. We were interested to see to what extent the executives were openly data-driven and ready to discount their own intuition when the data contradicts it.

We found that people generally relied too much on experience and intuition and not enough on data. Executives were not ready to allow themselves to be overruled by the data (`Priority`).

- "*When data are contradicting intuition/experience I'm relying on intuition.*"
- "*It's not a matter of trust, and more a matter of feeling, the data are only for support, the final decisions is based more on experience.*"
- "*Experienced management understands the business; they can easily spot gross or not so obvious inconsistencies in the data. We are not at the point where we can blindly rely on the data shown.*"

However, it is interesting to note that some respondents followed the expected approach to a BD transition when confronted with a decision context—by looking at the evidence first (followed by a deeper analysis of it) and then making appeal to their expertise and intuition (`Priority`).

- "*I look at the data first. If data would contradict my intuition this would be the first sign I need to dig deeper or include additional data in the analysis.*"
- "*I would validate the data from other sources.*"
- "*I would first question the accuracy of the data.*"
- "*When I make a decision 80% is based on data and 20% is based on intuition and experience.*"

An interesting response is: "*Data and intuition go usually hand in hand, a human person models data structures based on his experience/insight or intuition and afterwards the data confirms or corrects the intuition or expectation.*" However, this relates to data that is structured and stored accordingly, and not with BD, which is mostly unstructured. This indicates a misperception regarding the meaning and implications of BD (`Priority` and `Passive`).

Table 12. Data alignment.

	C-Trust
Priority	Strong: Experience takes priority over data.
	Weak: Experience is modulated by data.
Passive	Failure to comprehend the implications of moving to a BD&BA-driven decision-making culture.

5.6. Discussion

The model we develop in this section distils the content of the responses we obtained from the executives we surveyed and provides an additional organizational structure of this content in terms of 9 major focus areas (categories) subsuming a set of 17 interrelated and overlapping concepts.

It is very important to note that the emergent theoretical structure is a *graph* and not a *tree*; some concepts appear under more than one category and should be understood to indicate a significant connection under distinct headings. Such a connection may be confirmatory or they may stand in opposition to one another across categories or even within a category. These connections and relationships are a major feature of the model, revealing key areas of importance that are not evident from the raw data or from an informal analysis. We now use these to organize our discussion here, and for our conclusions in Section 6.

5.6.1. Passivity

By far the most striking emergent structure in the model concerns the concept `Passive`. This appears under no fewer than five of the nine categories. Specifically, we have: `C-Awareness:Passive`, `C-Impact:Passive`, `C-Approach:Passive`, `C-Action:Passive`, and `C-Trust:Passive`. We deal with this first, as it has implications for most of the areas that we cover below.

There are a series of distinct and more-or-less serious issues concerning passivity. First, there is evidence of companies who have not recognized the importance of BD and may suffer consequences as a result. Within organizations, there is a cultural distinction between those whose employees are proactive in this space and those where employees are either reactive and instructed (`C-Awareness:Passive`).

Second, there is evidence of organizations that *know what they do not know* and are taking up various positions to address that. These companies are self-educating, and, for example, proactively engaged in training (internally and externally). In the absence of full competence and external best practices, they vary in their current degree of commitment (`C-Approach:Interested` and `C-Approach:Skeptical`).

Third, and of most concern, there is evidence of organizations that *do not know what they do not know*. This is clear from responses that indicated misunderstandings and faulty strategy. For example, there is evidence that some organizations were failing to assess their real opportunities (`C-Impact:Passive`) and were not taking appropriate actions (`C-Action:Passive`), e.g., in committing to change, investing wisely, and developing appropriate human resource roles and skills.

Finally, and as we now turn to in more detail, there is evidence that deep consequences of adopting BD&BA in PM, specifically the *nature* of the data involved and its *normative role* in decision making, were not at all well understood and that this lack of understanding is, itself, not currently recognized. The most common misunderstandings relate to the nature of BD, in terms of necessary accuracy and its degree of structuring. Considering that the interviewees had been exposed to these subjects during their MBA studies, this misconception is quite concerning.

All these matters regarding passivity, whether due to oversight or lack of understanding, have important implications that we discuss in Section 6.

5.6.2. Trust

The category `C-Trust` covers some key findings of this research. Managers were not yet willing to fully trust data and to let it replace their judgments or intuitions in a particular decision-making

context (especially when that data contradicts their judgment and intuition). However, they relied heavily on data and they needed data to support their actions: they looked for data to support their actions; however, in these cases, the most common approach is to question the data and not to question their judgments.

The general lack of trust in data accuracy and quality is another aspect that requires attention. BD does not need to be precise and accurate, but the managers' attitudes towards data reflected their existing experience and their frustrations relating to the data that they currently use (structured data, stored in organizations' data bases and data warehouses).

At present (`C-Trust:Priority`) managers either remained (strong) wedded to existing priorities in which their experience is normative with respect to the data, or (weak) were somewhat ambivalent regarding the priority of their experience and instincts with respect to the data. Taking the data as normative is currently not an attitude that is present. In part these matters are consequences of `C-Trust:Passive`, i.e., fundamental misunderstandings regarding BD&BA, which we covered in Section 5.6.1, above.

This is perhaps to be expected, as data-driven organizational models are only in their infancy and current mental models are still trapped in the paradigm of small data, in which all the analytics are mostly based on causalities. However, any initiative aimed at establishing a data-driven culture has to consider people's current attitudes and how these can be modified to accept and empower data. Research results such as this can contribute directly to the development of appropriate initiatives.

5.6.3. Approach

The managers responding to our reflection guide fell quite clearly into three main categories. However, these self-identifications are modulated by issues (`C-Approach:Passive`) that we discussed in Section 5.6.1, above: They position themselves based on their current understanding, which may to some extent be flawed.

However, notwithstanding those considerations, we note those who are committed (`C-Approach:Interested`) sometimes lack good examples of best practices in order to take that desire to fully commit toward forward action. In some cases, this lack of best practices has resulted in managers presently taking a more conservative position (`C-Approach:Skeptical`), among others who have concluded that there are no benefits at all from embracing an approach to PM based on BD.

On the other hand, and perhaps driving the agenda, are the proselytes (`C-Approach:Enthusiast`), mostly from IT companies, who are working both intra- and inter-organizationally to develop awareness (`C-Awareness:Active`) and the best practices that other, mostly non-IT-based companies, feel are currently lacking.

5.6.4. Performance Management

Many of the overlapping concepts arise under the general rubric of performance management, our main focus in this paper. This confirms our initial assumption relating to the timeliness of PM as a focus for investigating a data-driven approach.

There is currently a tension in terms of focus: where to place attention. As a limiting factor, there are concerns about a lack of focus, in organizational vision and commitment, and in the organization's ability to respond rapidly to the changing circumstances (`C-Limits:Focus`). In contrast, there is also evidence that some are recognizing that a clear agenda of investment and deep organizational change is warranted (`C-Action:Focus`).

There is a similar tension in the area of skills: who to hire and what capabilities are required. A lack of available talent in the market, mostly technical but also business-oriented, is seen as a limiting factor (`C-Limits:Skills`). However, there was recognition that a strategic approach is required. Unfortunately, this was accompanied by a failure to understand exactly what skill sets are needed, the implications of which we take up fully in Section 6 (`C-Action:Skills`). Associated with this was the very limited evidence we obtained in the area of privacy (`C-Limits:Privacy`).

There was a rich understanding of the benefits of BD&BA in PM. First, the way in which new approaches to PM should be embedded in the organization (`C-PM-Normative:Integration`), the contribution new approaches to PM should directly impact on performance and its indicators within the organization (`C-PM-Normative:Performance`), and ways in which new approaches to PM should lead to the strategic development of the organization (`C-PM-Normative:Development`). These general normative views are extended by what were seen as specific and related requirements for business reporting (`C-PM-Visualization:Integration`, `C-PM-Visualization:Performance`, and `C-PM-Visualization:Development`).

In addition, there were clear expectations of benefits. These mostly concerned efficiency and timeliness (`C-PM-Descriptive:Efficiency` and `C-PM-Descriptive:Timeliness`) both generally and, in particular, for performance management (`C-PM-Visualization:Efficiency` and `C-PM-Visualization:Timeliness`). Specifically, these expectations concern more agile and informed decision-making.

6. Conclusions

This paper has explored executives' perceptions regarding the transformations of their business environments generated using BD&BA and their expectations regarding new data-driven PM models. Any initiative to implement a data-driven culture within organizations should be first considered from a managerial approach. We believe this is a first attempt to explore the consistency between PM and BD&BA from this non-technical perspective.

In order to address the research questions and the more specific themes of our research framework (Section 3) we invited executives from 21 Romanian organizations to reflect on a range of issues relating to BD&BA and their impact on organizations, with a particular focus on PM. As the success or failure or of any organizational change prompted by new information technologies depends primarily on the perceptions, understanding, and attitudes of the people involved, we considered a qualitative approach to be the most appropriate for our needs. We adopted a methodology based on GT and developed, as a research instrument, a reflection guide (Section 4).

The data arising from the responses was subject to analysis resulting in a conceptual model comprising 9 general categories and 17 interrelated and overlapping concepts. This model provides both a summary of the main themes that emerge from the responses, together with a structure that provides useful indications of relations between various concepts between and within the categories. We presented our findings, based on the data as represented in the conceptual model, in Section 5.

We devote the remainder of this concluding section to what we see as the management implications of our findings (Section 6.1), limitations of the current investigation (Section 6.2), and finally, to our future research directions (Section 6.3).

6.1. Managerial Implications

6.1.1. Raising Awareness and Understanding

One of our most important findings concerns the level of understanding of these new technologies. We found that the passive attitude is determined mostly by ignorance, self-assessed or otherwise, and manifested in different ways: failures of knowledge, of understanding, and of self-assessment.

This result has broad implications. We generally identify managers as holding exclusive responsibilities for implementing the data-driven culture within their organizations. However, there are other stakeholders that have to support these processes. The education system, for example, should address this problem. Currently, universities are struggling to design programs to prepare data scientists, as there is a wide recognized lack of such professionals, as identified in our findings. They should, however, offer programs to prepare managers, ensuring that they have the appropriate knowledge and skills to effectively approach and manage data-driven businesses.

From a managerial point of view, it is important to be appropriately positioned within one of the approach categories that we identified, before taking any further action regarding BD&BA. We are aware that this is not a simple task. First, it is hard for people to recognize that they actually do not know and understand things that they believe they do. Second, it is equally difficult to reconsider your position relating to BD, as the dynamic of transformations related to it is very high. Third, there are cases in which the managers' skepticism is determined by a thorough analysis of the appropriateness and benefits of using BD&BA in their businesses; an attitude that, if supported by a solid analysis, is a wise one.

6.1.2. Setting Goals, Assessing Benefits, and Understanding Limitations

A clear and detailed definition of the organization's business goals and context is crucial, as is an appropriate assessment of the benefits and limitations of BD&BA.

It is very important to recognize that the process of becoming data driven, like any other IT project in an organizational context, is primarily directed to a business, and not to a technology goal. This issue can easily be overlooked, as BD is still a somewhat fashionable concept.

Managers should not expect BD&BA to solve all their problems, both identified and unidentified. They have to clearly define their problems, formulate the questions, and indicate what data should be explored in order to respond to them. Data will bring useful insights and, more importantly, actionable information only if the entire exploration process is set in the right business context.

Any BD initiative should be carefully evaluated in terms of potential benefits and limitations in the particular business context addressed. Managers should not overestimate BD and have unrealistic expectations.

6.1.3. Learning to Trust Data

The new data-driven paradigm almost seduces organizations with the promise of new and valuable insights. At the same time, it weakens the decision-making role of the currently accepted "decision-maker," but without reducing their responsibilities for those decisions. This clearly raises social, and especially ethical, issues that companies need to address. There also remain challenges in establishing an appropriate alignment between data and decision maker: finding the right balance between the evidence coming from data versus human knowledge in decision making.

According to our findings, these issues of data alignment are the most critical issues raised by BD&BA. However, this is difficult in the absence of best practices, reliable testing of data, and appropriate education. Such practices, tests, and training opportunities need to be developed.

6.1.4. Commitment to the Data-Driven Culture

Our findings suggest that organizations should:

- Understand what BD implies and what the potential benefits are for the organization.
- Design a comprehensive strategy. Implementing a data-driven decision-making model at the organizational level needs an integrated and broad approach.
- Inspire others, share best practices, and design and implement BD&BA projects in areas that can most easily be mastered. Our findings suggest that PM is a good choice.
- Develop and implement human resources policies to attract and hire data specialists, including not only data scientists, but also other roles, such as data translators, which our findings suggest are not yet well understood.
- Create a collaborative environment: our findings isolated commitment to integration and embedding a culture of BD&BA within the organization as crucial.
- Measure and monitor the results: our findings suggest that this is one important way to improve trust in data and to develop an appropriate alignment between data and decision maker (see also Section 6.1.3, above).

As we have discussed in the body of the paper, it is already clear that change management plans can benefit from the results we have obtained, but it is equally clear that these plans will be very challenging to develop and to implement. The process of transitioning to a data-driven organizational model is new, complex, and currently there are few best practices to guide it. If the themes discussed in this article were explored further, and more deeply; for example, by canvassing views from multiple respondents at differing levels and with differing responsibilities, more refined conclusions might be drawn, providing further guidance for the development of change management strategies (see also Section 6.3, below).

It is worth noting that, despite significant differences in understanding, maturity, attitude, and engagement, all managers have a great interest in BD&BA and their impact on businesses. This is reflected in the observation that all of our respondents asked us to share the results of our study with them because they see them as useful to their future development.

6.2. Limitations

A total of 21 participants engaged with our research. Although this is not a large number of individuals, they represent 21 different companies of different industries, size, and type. Most of these companies are part of important multinational groups. As the respondents hold senior, and consequently, influential positions, we have elicited views that currently condition the role of BD&BA within their organizations.

We would have wished to be in a position to compare our findings with similar studies in other locations. There is, however, almost no relevant published research to date. Most closely relevant are References [2] and [28]. The former is a U.S.-based survey. However, 55.6% of the respondents were chief data officers, 15.3% were chief analytics officers/chief data scientists, and 13.9% were chief information officers. This IT-focused constituency does not constitute a good match for our own, which specifically sought to gauge opinion mostly from business executives. The latter is potentially more relevant in terms of the class of respondents. However, this case study involves just one multinational company, seeking to uncover differences in perceptions and attitudes *within* a company rather than *across* a range.

6.3. Future Research

A number of future research directions emerge from our findings. First, the very strong results concerning passivity suggest the need for a deeper analysis, with a view to establishing appropriate management and broader, social, interventions. Those findings concerning institutions' self-assessed weaknesses of understanding should be considered further, with investigations being generalized to providers of such knowledge, e.g., the role and challenges raised for the education system—in particular, the Universities—in this context. Those findings concerning the failure of organizations to self-assess weaknesses in their understanding are more challenging, but appropriate research methodologies need to be developed and implemented in order to explore this further. Such investigations should refine our findings concerning appropriate skill sets, roles, and their shortages.

Second, a deeper analysis of how and to what extent PM models need to be reviewed and reframed in the BD era is required. There is considerable evidence of enthusiasm for this aspect of BD&BA, and our findings show that many organizations have quite clear ideas about what they should expect and what they would like to see emerge from greater integration. However, more needs to be done here.

Third, the issue of trust is an important area emerging from our findings. As we discussed in Section 6.1.3, finding the right balance of trust between data and decision maker, for optimum performance is a major challenge, and one that would benefit from a thorough investigation of practices, as they continue to develop.

Fourth, our findings revealed issues, such as privacy, concerning the ethical and social issues relating to BD and to the "datafication" of the economic environment. These are clearly of major importance but were not by any means central to our current work. A targeted investigation in this area would be valuable.

Finally, in line with our comments in Section 6.1.4, a parallel investigation to that cited in Section 6.2 [29] that takes an in-depth investigation into a single large organization would provide an opportunity for a point-by-point comparison with the prospect of general results.

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Appendix A

Reflection Guide:

Regarding managers' opinion of Big Data and business analytics and their impact on performance management processes

This reflection guide aims to investigate management attitudes towards business analytics and Big Data and its relationship to performance management. This is an anonymous survey and the answers will be used only for academic purposes.

1. How have you and those in your company become aware of the potential opportunities and benefits offered for the business by Big Data and business analytics?
2. In what ways and to what extent would you describe your company as already being a data-driven organization?
3. When considering your company's strategic needs as a data-driven organization, what resources do you currently see as limiting factors? For example, the availability of data itself, the required skills to process it effectively, identifying opportunities for obtaining business value from data, management attitude, employee attitude, etc.
4. In the context of your previous answer, what plans are your company considering, in order to address the challenges that you have identified? For example, hiring specialist staff (data scientists), training activities, change management activities, changes to IT systems and processes, etc?
5. Business performance management systems are currently based on business intelligence technologies. In what ways do you see Big Data and Big Data analytics as contributing to business performance management systems?
6. In what ways do you see Big Data and business analytics changing your approach to performance management in your company?
7. In what ways do you see Big Data and business analytics reshaping the content and significance of performance management reports (for example, balance scorecards and dashboards)?
8. To what extent do you trust evidence coming only from data when you make a decision? What would you do if the data contradicts your intuitions and prior experience in a particular situation?

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