UNIVERSIDADE DE LISBOA

ISEG – Instituto Superior de Economia e Gestão

Business Benefits from Big Data Analytics: A Multiple Case Study Approach

Flávio Alexandre Costa Romão

Orientador: Professor Doutor Mário Fernando Maciel Caldeira

Tese especialmente elaborada para obtenção do grau de Doutor em Gestão

2024

UNIVERSIDADE DE LISBOA

ISEG – Instituto Superior de Economia e Gestão

Business Benefits from Big Data Analytics: A Multiple Case Study Approach

Flávio Alexandre Costa Romão

Orientador: Professor Doutor Mário Fernando Maciel Caldeira

Tese especialmente elaborada para obtenção do grau de Doutor em Gestão

Júri:

Presidente: Professor Doutor Eduardo Barbosa do Couto
Professor Associado e Presidente do Departamento de Gestão do Instituto Superior de Economia e Gestão da Universidade de Lisboa

Vogais: Doutor Tiago André Gonçalves Félix de Oliveira
Professor Catedrático, Nova IMS

Doutor Henrique José da Rocha O'Neill
Professor Associado com Agregação, ISCTE – Instituto Universitário de Lisboa

Doutor Mário José Batista Romão
Professor Associado com Agregação, Instituto Superior de Economia e Gestão da Universidade de Lisboa

Doutor Jesualdo Cerqueira Fernandes
Professor Auxiliar, Instituto Superior de Economia e Gestão da Universidade de Lisboa

Doutor Mário Fernando Maciel Caldeira
Professor Catedrático, Instituto Superior de Economia e Gestão da Universidade de Lisboa

2024

Acknowledgements

This thesis was only possible with the support and contributions of various individuals and organizations who generously participated in the research. While the organizations involved in the case studies must remain anonymous, I wish to express my profound gratitude to those who were involved.

Undertaking a PhD is a journey filled with numerous challenges, demanding perseverance on multiple levels. My supervisor, Professor Mário Caldeira, played a crucial role in guiding me to the completion of this journey. His timely challenges to my ideas, coupled with his motivational support at critical junctures, were essential in pushing me forward to achieve a successful outcome. Professor Mário, thank you for your guidance and support.

I also wish to extend my gratitude to all my colleagues in the program who, especially in the first year, were a significant source of both inspiration and motivation. Furthermore, I am grateful to the faculty at ISEG, among whom I had the privilege of being a colleague of some. Although I am avoiding naming individuals, I thank Professor João Mota for his early belief in my potential and for being the first to invite me to lecture at ISEG.

Last, but certainly not least, I must express my deepest gratitude to my family. First to my wife, Sara, who lived through this adventure close to me, endured many hours without my presence, but continually encouraged me, read the manuscript, and provided insightful comments. To my parents and my brother, and to those who are no longer physically with us, for one must never forget our roots and where we came from, as they will forever be a part of us. In moments like this, Irene and Américo, you are especially in my thoughts.

Abstract

Big Data Analytics Capabilities (BDAC) are increasingly acknowledged for their transformative impact on business practices and strategic frameworks by both practitioners and the academic community. Despite heightened interest, detailed research into the specific business benefits of BDAC is notably limited, with existing studies often adopting alternate analytical lenses. This research explores the realization of business benefits from BDAC across diverse sectors within the Portuguese market, employing Benefits Management lens based on a multiple case study research strategy. Concentrating on the primary commercial and operational activities within four distinct industries, this study examines the role of BDAC and its enablers in fostering revenue growth, cost efficiency, customer engagement, and compliance. Key findings stress the criticality of multidisciplinary collaboration, data democratization, and the strategical differentiation between traditional and advanced analytics. Additionally, this study provides insights into various organizational models – centralized, decentralized, and hybrid – offering significant perspectives on optimizing BDAC deployment for strategic leverage.

Keywords: Big Data Analytics Capabilities; Benefits Management; Business Benefits; Multiple Case Studies; Data Democratization

Resumo

As capacidades de analítica de big data (BDAC) são cada vez mais reconhecidas pelo seu impacto transformador nas práticas empresariais e estruturas estratégicas, tanto por profissionais como pela comunidade académica. Apesar do crescente interesse, a investigação detalhada sobre os benefícios de negócio específicos das BDAC é limitada, com estudos existentes frequentemente a adotarem lentes analíticas alternativas. Esta pesquisa investiga a concretização de benefícios de negócio das BDAC em empresas de diversos setores do mercado português, utilizando uma visão de gestão de benefícios baseada numa estratégia de investigação de estudo de caso múltiplo. Concentrando-se nas atividades comerciais e operacionais primárias de quatro indústrias distintas, este estudo examina o papel das BDAC e os seus impactos no aumento de receitas, eficiência de custos, envolvimento do cliente e conformidade. Os principais resultados sublinham a importância da colaboração multidisciplinar, democratização de dados e a diferenciação estratégica entre análises tradicionais e avançadas. Adicionalmente, este estudo oferece perspetivas sobre vários modelos organizacionais - centralizados, descentralizados e híbridos - fornecendo perspetivas relevantes para otimizar a implementação das BDAC para alavancagem estratégica.

Palavras-chave: Capacidades analíticas de big data; Gestão de Benefícios; Benefícios de Negócio; Estudos de Caso Múltiplos; Democratização de Dados

Contents

Figures

Tables

Abbreviations

AI – Artificial Intelligence

API – Application Programming Interface

ARPU – Average Revenue per User

B2B – Business to Business

B2C – Business to Consumer

BDA – Big Data Analytics

BDCA – Big Data Analytics Capabilities

BDN – Benefits Dependency Network

BI – Business Intelligence

BSS – Business Support Systems

CRM – Customer Relationship Management

IS – Information Systems

IT – Information Technology

IVR – Interactive Voice Response

KPI – Key Performance Indicator

MiFID – Markets in Financial Instruments Directive

NBO – Next Best Offer

NPS – Net Promoter Score

OKR – Objectives and Key Results

OSS – Operations Support Systems

P&S – Products and Services

RBV – Resource-based View

VRIO – Value, Rarity, Imitability, and Organization

Chapter I – Introduction

1.1 Research Motivation

Big Data Analytics Capability (BDAC) is recognized in academic literature for its profound impact on business practices and strategic paradigms. Its influence spans several dimensions, including revolutionizing firm operations (Barton & Court, 2012; Davenport, 2006), catalysing innovation (Gobble, 2013), embodying a new (fourth) science paradigm (Strawn, 2012), sparking a management revolution (McAfee et al., 2012), emerging as a novel paradigm of knowledge assets (Hagstrom, 2012), and holding the potential to reshape both theoretical frameworks and practical methodologies (George et al., 2014). As such, BDAC has garnered attention as a crucial element for organizational investment, increasingly recognized by academical research and by practitioners as being key for securing sustained competitive advantage (Akter et al., 2016).

The interest in BDAC from both the research and practice communities underscores the importance of this phenomenon (Ranjan & Foropon, 2021). However, academic research has predominantly focused on technical solutions (Chen et al., 2012; Baesens et al., 2016; Lau et al., 2016; Günther et al., 2017), leaving a gap in understanding not only the specific business benefits these capabilities offer but also the mechanisms through which they are realized. Regarding the understanding of benefits, while the vast majority of the research does not have that focus, it is still possible to identify benefits of efficiency for example when applied to supply chain (Wang & Alexander, 2015), as well as benefits directly related with areas such as: research and development, development of products and services (Shahid & Sheikh, 2021), customer relationship management, risk management, and fraud detection (Elgendy & Elragal, 2014) just to name a few. Still, those benefits are often presented both at a high level and as outcomes. As for their realization, with the notable exception of Jensen et al. (2023) that still is more focused on the benefits management process, there is, to the best of our knowledge, a significant gap in the literature.

This gap may result from the complex and multifaceted nature of these benefits, which presents challenges for practical investigation, even more when encompasses multiple factors that include technology, process, and people (Oesterreich et al., 2022). The prevalence of confirmatory studies, while useful for validating hypotheses, may limit the discovery of new insights. Consequently, the exploration of the business benefits attributable to BDAC remains relatively underexplored in the current body of knowledge (Trieu, 2017; Müller et al., 2018; Jensen et al., 2023). This oversight becomes particularly pronounced when acknowledging that the realization of benefits frequently relies on specific contextual implementations (Mikalef et al., 2018; Jensen et al., 2023), adding another layer of complexity to their analysis.

The significance of BDAC and the limitations identified in previous research not only motivated this study but also informed its foundation on prior work. Adopting a novel methodological approach, grounded in the incorporation of benefits management as an analytical lens, this research aims to overcome some limitations of past studies and contribute to the existing body of knowledge with novel finding related with this increasingly relevant topic.

An in-depth analysis, anchored in theoretical frameworks previously employed in research but viewed through a recalibrated lens, is expected to enrich our understanding. The Resource-Based View (Günther et al., 2017), dynamic capabilities theory (Wamba et al., 2017), and sociomaterialism (Akter et al., 2016) have supported efforts to comprehend BDAC adoption's implications. However, exploring this phenomenon from a benefits management perspective (Ward & Daniel, 2012) is anticipated to not only broaden our current understanding but also reveal new insights and make contributions that are theoretically and practically valuable, supporting the development of future research while providing relevant findings that can guide practitioners in new BDCA-related endeavours.

1.2 Research Questions

Building upon current literature, this study seeks to elucidate how companies – particularly within their commercial and operational activities – realize benefits from BDAC. While prevailing research primarily emphasizes technical solutions or evaluates its effect on firm performance (e.g., Alyahya et al., 2023), this research employs benefits management lens to probe into the distinct benefits and strategic impacts enabled by BDAC. Consequently, this directs us toward the primary research question of our research:

RQ1: How do firms benefit from big data analytics capabilities?

This study also addresses two secondary research questions. The first concerns the processes and strategies essential for the enablement of BDAC, specifically aiming to clarify the organizational changes required to harness these capabilities effectively for realizing business benefits. The second question seeks to deepen the understanding of organizational design decisions crucial for optimizing BDAC exploitation, especially in the context of escalating investments in capabilities under this scope. Therefore, the secondary research questions are articulated as follows:

RQ2: How do firms enable big data analytics capabilities to realize business benefits?

RQ3: How do firms organize teams for big data analytics capabilities?

Considering that the research questions posed are 'how' questions, this study adopted a research strategy deemed appropriate for addressing such inquiries (Yin, 2018). Specifically, a case study methodology was employed, involving four distinct cases representing large companies operating in the Portuguese market. This design is aligned with the objectives of exploring how can firms benefit from BDAC, regardless the industries where they operate.

1.3 Thesis Structure

This document, beyond the introduction, comprises five main chapters. The second chapter, a comprehensive literature review, seeks to delineate key concepts and theories pertinent to this thesis. It also aims to provide a current state-of-the-art overview of the existing knowledge on the business benefits derived from BDAC.

The third chapter delineates the methodological framework employed in this research, detailing the rationale behind the selected approaches and techniques. It presents the methodological decisions undertaken to ensure the robustness and validity of the findings within the context of exploring the business benefits of BDAC. This includes an overview of the research design, data collection methods, analytical techniques, and the criteria for data interpretation.

The fourth chapter presents the four case studies developed within the context of this research, including an individual analysis of each case These analysis aim to understand the positions of the examined companies regarding BDAC, to clarify the benefits these companies realize from such capabilities, and how the realization of such benefits occurred.

While chapter four is dedicated to the individual analysis of each case study, Chapter five advances with a cross-analysis. This comparative approach is guided by the research questions, the significant themes that have emerged from the individual analysis, and the insights obtained from current academic literature. This chapter also discusses the key findings derived from both the thematic and cross-analytical processes, contextualizing them under the lens of the theories followed, and focussing those that are considered the most relevant contributions of this research.

Chapter Six culminates this research by synthesizing the conclusions drawn, detailing the primary contributions to the academic field, methodological advancements, managerial implications, and outlining both the limitations encountered and directions for future research.

Chapter II – Literature Review

This chapter presents a literature review aimed at outlining the key concepts and theoretical perspectives that support this thesis. It begins by elucidating fundamental concepts identified in previous research on the phenomenon, as well as introducing the theories used to adjust the lens through which this research was conducted. This contextual exploration spread from an introduction of core concepts, such as information systems, to more specific discussions, including core concepts such as big data analytics capabilities, but also a reflection on data democratization. Additionally, organizational topics are examined to frame the empirical findings effectively.

The theoretical perspectives introduced here lay the groundwork for the research design, particularly in ensuring that data collection strategies are aligned with the thesis's primary research questions and adjusted with the intended theoretical lens. Furthermore, they informed the analysis made over the data collected also supporting its rigor.

2.1 Benefits Management within an IS/IT Context

This thesis explores a phenomenon within the domain of Information Systems (IS), supported by Information Technology (IT). Despite the diverse perspectives presented in the literature (Baskerville et al., 2015), this study adopts an integrative approach to IS and IT. Laudon & Laudon (2015, p. 47) define Information Systems as “a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision-making in an organization”. Complementing this, Ward & Daniel (2012, p. 17) describe IS as “the means by which people and organizations, utilizing technology, gather, process, store, use, and disseminate information”. This thesis aligns with a synthesis of these definitions, viewing IS as the mechanisms through which people and organizations, by the use of technology, gather, process, store, use, and disseminate information to facilitate decision-making. Additionally, Information Technology is characterized as "shared technology resources that provide the platform for the firm’s specific information system applications" (Laudon & Laudon, 2015, p. 195). IS, IT and IS/IT are going to be used interchangeable throughout this document.

Benefits Management is “the process of organizing and managing such that the potential benefits arising from the use of IS/IT are actually realized” (Ward & Daniel 2012, p. 8). Clarifying the concept of benefit is essential in this context. In this thesis, a benefit is defined as an outcome that is deemed advantageous by an organization, characterized by its nature and value, and is pursued by individuals or groups seeking to derive value from an investment (Yates et al., 2009). This value can be categorized as either tangible, with direct financial expression such as increased sales, or intangible, like enhanced customer satisfaction, which contributes to overall business value but does not directly impact financial metrics (Jensen et al., 2023).

Additionally, Peppard et al. (2007) present five principles for realizing business benefits, which are relevant and guide this research. These principles, which are: (1) IS/IT has no inherent value; (2) Benefits arise when IT enables People to do things differently; (3) Only business managers and users can release business benefits; (4) All IT projects

have outcomes, but not all outcomes are benefits; and (5) Benefits must be actively managed to be obtained, are described in Table 1. Furthermore, the terms business benefit and value are often used interchangeably, though they encompass distinct concepts. Under the context of this thesis, business benefits refer specifically to the gains or improvements realized as a result of organizational changes. In contrast, value often represents a measure calculated as the benefits minus the costs incurred to achieve these benefits (Jensen et al., 2023), which is not under direct focus in this research.

The process model for benefits management, illustrated in Figure 1, supports a better understanding of benefits management. It builds upon Pettigrew & Whipp's (1991) model for strategic change, suggesting that impactful change must be contextually relevant. Additionally, this model incorporates principles from Total Quality Management and business improvement methodologies such as Six Sigma, aiming for excellence (Ward & Daniel, 2012). The model unfolds in five sequential steps: (1) identifying and structuring benefits, this initial step focuses on pinpointing potential benefits from IS/IT investments and organizing them to facilitate effective management and measurement; (2) planning benefits realization, at this stage, comprehensive plans are formulated to achieve the identified benefits, which includes designating responsibilities and establishing timelines; (3) executing the benefits plan, This involves the practical implementation of the benefits realization plan, required changes to processes, systems, and organizational structures; (4) post-execution, the realized benefits are assessed against the initial plans to evaluate the success of the benefits realization effort, potentially leading to replanning; and (5) establishing the potential for further benefits, this final step concentrates on leveraging the achieved benefits optimally and exploring avenues for further enhancement.

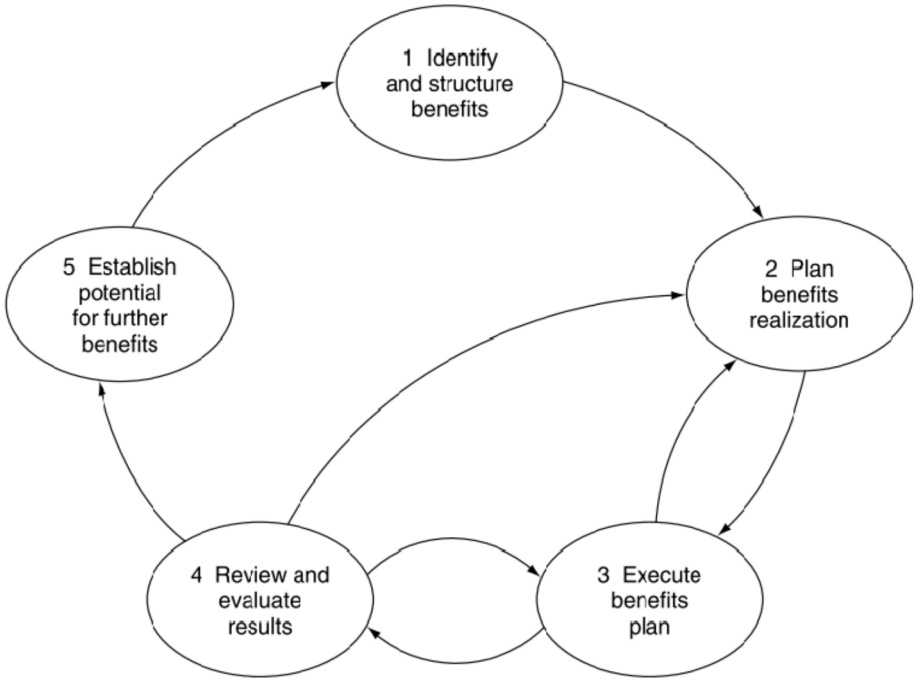
Table 1: Principles for Realizing Benefits Through IS/IT

Principle	Description
IS/IT has no inherent value	Just having technology does not confer any benefits or create value. Unlike many other assets, such as real estate, the value of technology is not in its possession. In fact, IS/IT spending only incurs costs. Benefits result from effective use of the IS/IT asset.
Benefits Arise When IT Enables People to Do Things Differently	Benefits emerge only when individuals or groups within the organization, or its customers or suppliers, perform their roles in more efficient or effective ways. Generally, these new ways of working require improving how information is used. Technology can enable and shape such new ways of working through redesign of intra- and inter-organizational processes or by facilitating new work practices.
Only Business Managers and Users Can Release Business Benefits	Since benefits result from changes and innovations to ways of working, only business managers, users, and possibly customers and suppliers, can make these changes. Therefore, IT and project staff cannot be held accountable for realizing the business benefits of IS/IT investments. Business staff must take on this responsibility. Getting business staff to acknowledge this principle is a key way to ensure that they become involved in so-called "IT projects."
All IT Projects Have Outcomes, But Not All Outcomes Are Benefits	This simple, yet profound, principle resonates with the reality that many IS/IT projects produce negative outcomes, sometimes even affecting the very survival of the organization itself. The challenges for management are to avoid such negative outcomes and to ensure that the positive outcomes deliver explicit business benefits.
Benefits Must be Actively Managed to be Obtained	Benefits are not outcomes that automatically occur. Furthermore, the accumulation of benefits lags implementation; there is a time gap between initial investment and payoff. Therefore, managing for the benefits does not stop when the technical implementation is completed. Benefits management needs to continue until all the expected benefits have either been achieved or it is clear they will not materialize.

Source: adapted from Peppard et al. (2007)

This cyclical process promotes continuous improvement and ensures that benefits from IS/IT investments are maximized, aligning closely with the strategic objectives and goals of the organization.

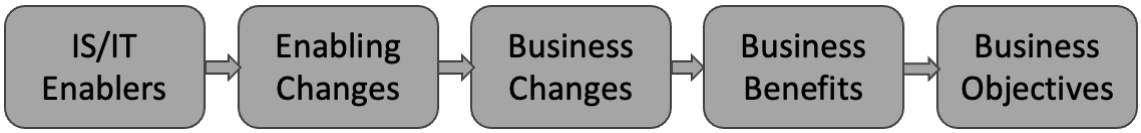
Figure 1: A Process Model for Benefits Management



Source: Ward & Daniel (2012, p. 69)

Another relevant contribution in the literature on benefits management is the concept of the Benefits Dependency Network (BDN). This network facilitates a cause-and-effect approach, illustrating how benefits can be realized through a combination of business changes and IS/IT capabilities (Peppard et al., 2007). The BDN, structured as depicted in Figure 2, conceptualizes business benefits as outcomes of business changes, which are, in turn, driven by IS/IT enablers and the resultant enabling changes. Additionally, these networks clarify the relationship between business objectives and the realized business benefits, offering a comprehensive view of how strategic goals are achieved through IS/IT interventions.

Figure 2 – Benefit Dependency Network Structure



Source: adapted from Ward & Daniel (2012)

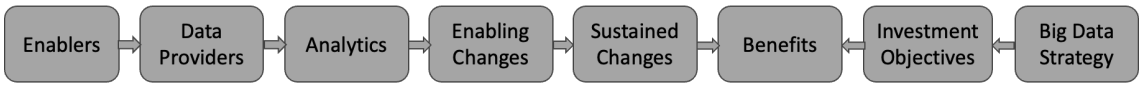
Examining the components of the Benefits Dependency Network (BDN), IS/IT Enablers are identified as the essential information systems and technology that support the realization of benefits and facilitate the necessary organizational changes. These enablers represent the capabilities provided by IS/IT to achieve strategic objectives (Peppard et al., 2007). Enabling Changes, on the other hand, constitute the prerequisites for implementing business transformations that enhance system effectiveness within the organization. Coupled with Business Changes, which denote new operational methodologies, these two elements stress out the transformations required to leverage the means provided by IS/IT.

The preceding components of the BDN culminate in the achievement of business benefits, which requires alignment with strategic objectives. Ward & Daniel (2012) emphasize that each benefit should be assigned an owner responsible for its realization. This typically entails ensuring that enabling changes are executed as anticipated. Additionally, it is pertinent to acknowledge the significance of Business Drivers. These represent the critical issues identified by top management as necessitating change and often guide the definition of business objectives. These drivers can be both internal or external to the organization and are highly context-dependent.

Jensen et al. (2023) based on the previously presented BDN have contributed with a significant revision to the benefit dependency network, as part of an action research project (see Figure 3). The revised model delineates some relevant modifications as is the case of the Enablers that include various projects and technologies essential for BDAC success. Data Providers are defined as the repositories of data, such as big data repositories and data warehouses. Analytics encompasses business intelligence tools and

statistical methods that convert data into actionable insights for decision-making. These modifications combined encompass what was previously categorized under IS/IT Enablers.

Figure 3 – Vestas' Benefit Dependency Network structure



Source: Jensen et al. (2023)

The concept of Enabling Changes retains its original premise, while Sustained Changes align closely with what was formerly described as Business Changes. Similarly, the model's approach to Benefits and Investment Objectives continues to follow the logic of its predecessor, in the case of the latter broadly corresponding to the previously defined Business Objectives. A relevant addition in this model is the Big Data Strategy, introducing a strategic framework aimed at preventing the formation of silos, marking a significant evolution from the earlier model (Jensen et al., 2023).

In this thesis, we will employ a benefits management framework to structure our findings, with a specific focus on the model initially proposed by Ward et al. (1996) and further developed by Ward & Daniel (2012). This model was selected due to its alignment with the research questions we aim to address. The framework proposed by Jensen et al. (2023), despite its detailed IS/IT breakdown, was not deemed to add value to our research focus, which centres on understanding how companies derive benefits from BDAC and the organizational mechanisms supporting this. Moreover, unlike the case of Vestas explored by Jensen et al., the companies studied do not possess explicit big data strategies, a factor that limits the applicability of the Jensen et al. model's additional component in our analysis.

2.2 Theoretical Approaches

Previous studies on big data analytics capability and its impact on companies often draw upon strategic management theories, with the Resource-Based View (RBV) being particularly prevalent (Günther et al., 2017). RBV is founded on two core assumptions: firstly, firms within a specific industry possess a unique, heterogeneous mix of resources (Peteraf & Barney, 2003); secondly, there exists a degree of resource immobility, meaning these resources are difficult to transfer between firms (Barney & Hesterly, 2010). When these conditions are met, synergistic effects arising from these resources are anticipated to yield sustained benefits. Within the RBV framework, the VRIO model posits that resources which are valuable (enhancing revenues and reducing costs), rare (limited to a few firms), imperfectly imitable (not easily replicated), and well-organized, are likely to have a positive impact on firm performance (Amit and Schoemaker, 1993).

At the heart of the RBV lies the interplay between resources and capabilities (Akter et al., 2016). Resources encompass both tangible and intangible assets, varying in nature from technological and human to organizational. Capabilities, on the other hand, are considered as specific subsets of a firm's resources. These are inherently non-transferable and are focused on enhancing the productivity of other resources (Makadok, 1999). It is also noteworthy that some capabilities, particularly those that are innovative, can lay the foundation for sustainable long-term competitive advantages (Porter & Millar, 1985).

Another concept of relevance in the literature, particularly within the scope of this thesis, is dynamic capabilities. In strategic management, this concept has emerged as a seminal framework, especially pertinent in environments characterized by rapid change. Teece et al. (1997) introduced dynamic capabilities as a firm's ability to integrate, build, and reconfigure internal and external competencies to address such changing environments. This approach extends the RBV by emphasizing strategic and adaptive processes that enable firms to achieve innovative competitive advantages. Eisenhardt & Martin (2000) further elaborated on this concept, identifying dynamic capabilities as specific strategic processes like product development, strategic decision-making, and

alliances. These processes are visible and repeatable patterns of organizational activity, vital for firms in fast-evolving technological sectors. Contractor et al. (2016) supports this perspective for information systems capabilities in organizations. Big data analytics systems, in particular, are regarded as providing a competitive edge during environmental turbulence due to their adaptability. Consequently, due to its alignment with dynamic capabilities theory, this approach is prominently utilized in studying big data-related phenomena (Wamba et al., 2017).

Akter's et al. (2016) study related with big data analytics capability sought for theoretical foundation on the concept of sociomaterialism. This concepted that has gained some traction in management and information systems research, posits that social and material aspects of organizational life are intricately interwind and inseparable (Orlikowski, 2007). This perspective challenges traditional dichotomies between technology and people, arguing for a more integrated approach to understanding organizational phenomena. Pioneering work by Orlikowski (2007) and Leonardi (2011) has been instrumental in developing this theory, emphasizing that the interactions between technology and social practices co-constitute each other. Sociomaterialism provides a lens through which the entanglement of human actions and materiality in organizations can be examined, revealing how they co-produce organizational outcomes. This perspective is particularly relevant in the context of big data analytics, where the interaction between advanced technological capabilities and human decision-making is critical (Leonardi, 2012; Orlikowski & Scott, 2008).

In the context of big data analytics capability, systems theory can offer a valuable perspective for comprehending how data analytics operates within the broader organizational framework. As von Bertalanffy (1968) posits, systems theory stress the necessity of holistically viewing organizations, a viewpoint that resonates with the complex nature of BDAC. Moreover, this theory introduces the concept of open system, which engages in dynamic interactions with its environment through information, energy, or material exchanges, unlike closed systems that remain isolated (von Bertalanffy, 1968). In the context of BDAC, data transcends being a mere isolated component,

evolving into an essential aspect of the organizational ecosystem that interacts with technology, processes, and human resources, whether internally or externally. This interaction is crucial for realizing the full potential of BDAC. Therefore, applying systems theory lens can enrich our comprehension of big data analytics capabilities.

2.3 From Big Data to Big Data Analytics Capability

The concept of big data, which has been defined by various authors (refer to Table 2), has gained increased relevance due to the expanding availability of data in firms. This increase in data availability is attributed to multiple factors: the proliferation of social networks; the continuous expansion of the internet; and the growing prevalence of mobile technologies (Kauffman et al., 2012). From a different perspective, the nature of this data varies, encompassing transactional data (such as structured data from transactions), clickstream data (like content from social media), video data (for instance, satellite footage), and voice data (including customer service call recordings) (Kauffman et al., 2012). Thus, big data comprising both structured and unstructured data promotes a paradigm shift evolving from the historical strong reliance, and almost exclusive use, of structured data.

The concept of big data can be distinctively characterized by the 7Vs framework which encompasses: (1) Volume, indicating the aggregation of a vast number of variables and observations (George et al., 2016); (2) Velocity, reflecting the rapid rate at which data is collected and analyzed, including real-time or near real-time processing (George et al., 2016); (3) Variety, denoting the diverse range of structured and unstructured data sources (George et al., 2016); (4) Veracity, ensuring data reliability, authenticity, and security (Demchenko et al., 2013); (5) Value, the potential economic benefits derived from data insights (Wamba et al., 2015); (6) Variability, relating to the adaptability in interpretation for insight generation due to media changes or new data sources (Seddon & Currie, 2017); and (7) Visualization, the ability to discern patterns and trends within data (Seddon & Currie, 2017). Thus, the multifaceted nature of big data significantly elevates the potential for value creation from data (El-Kassar & Singh, 2019). This

research is founded on the concept of big data, underpinned by the 7Vs framework. This framework is believed to comprehensively encapsulate the academic contributions to this subject, providing a multifaceted approach to understanding big data, aligning with the extensive academical discussion in this field.

The concept of big data analytics (BDA) encompasses a complex array of instruments and analytical techniques dedicated to storing, managing, analysing, and visualizing large and diverse datasets (Chen et al., 2012). Originating from the concepts of business intelligence and analytics, BDA represents an evolution towards a data-centric methodology, incorporating data collection, extraction, and analysis technologies (Chaudhuri et al., 2011; Watson & Wixom, 2007). This places BDA at the intersection of computer science, information management, and data management, as illustrated in Figure 4.

Figure 4 – Big Data Analytics

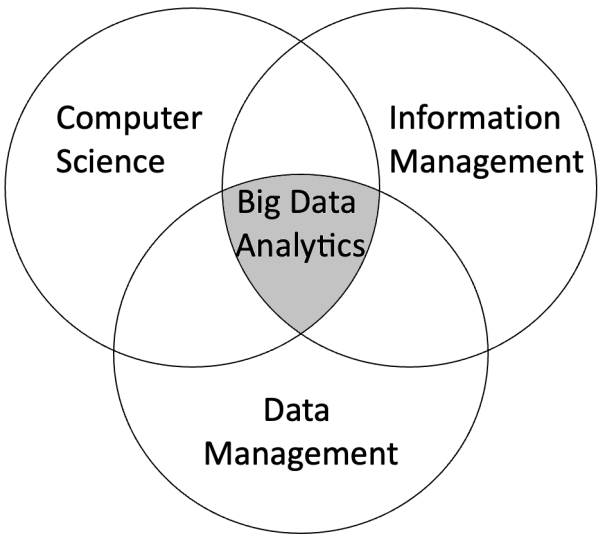


Table 2. Definitions of Big Data

Authors (s) and year	Definition
Russom (2011)	Big data involves the data storage, management, analysis, and visualization of very large and complex datasets
White (2011)	Big data involves more than simply the ability to handle large volumes of data; instead, it represents a wide range of new analytical technologies and business possibilities. These new systems handle a wide variety of data, from sensor data to Web and social media data, improved analytical capabilities, operational business intelligence that improves business agility by enabling automated real-time actions and intraday decision making, faster hardware and cloud computing including on-demand software-as-a service.
McAfee et al. (2012)	Big data, like analytics before it, seeks to glean intelligence from data and translate that into business advantage. However, there are three key differences: Velocity, variety, volume
Boyd & Crawford (2012)	Big data: a cultural, technological, and scholarly phenomenon that rests on the interplay of (1) Technology: maximizing computation power and algorithmic accuracy to gather, analyze, link, and compare large datasets. (2) Analysis: drawing on large datasets to identify patterns in order to make economic, social, technical, and legal claims. (3) Mythology: the widespread belief that large datasets offer a higher form of intelligence and knowledge that can generate insights that were previously impossible, with the aura of truth, objectivity, and accuracy
Schroeck et al. (2012)	Big data is a combination of volume, variety, velocity and veracity that creates an opportunity for organizations to gain competitive advantage in today's digitized marketplace
Bharadwaj et al. (2013)	Big data refers to datasets with sizes beyond the ability of common software tools to capture, curate, manage, and process the data within a specified elapsed time
Davis (2014)	Big data consists of expansive collections of data (large volumes) that are updated quickly and frequently (high velocity) and that exhibit a huge range of different formats and content (wide variety)

Authors (s) and year	Definition
Sun et al. (2015)	Big data: the data-sets from heterogeneous and autonomous resources, with diversity in dimensions, complex and dynamic relationships, by size that is beyond the capacity of conventional processes or tools to effectively capture, store, manage, analyze, and exploit them
Opresnik & Taisch (2015)	Big data typically refers to the following types of data: (1) traditional enterprise data, (2) machine-generated/sensor data, and (3) social data
Constantiou & Kallinikos (2015)	Big data often represents miscellaneous records of the whereabouts of large and shifting online crowds. It is frequently agnostic, in the sense of being produced for generic purposes or purposes different from those sought by big data crunching. It is based on varying formats and modes of communication, raising severe problems of semiotic translation and meaning compatibility. Big data is commonly deployed to refer to large data volumes generated and made available on the Internet and the current digital media ecosystems
Akter et al. (2016)	Big data is defined in terms of five 'Vs:' volume, velocity, variety, veracity, and value. 'Volume' refers to the quantities of big data, which are increasing exponentially. 'Velocity' is the speed of data collection, processing and analyzing in the real time. 'Variety' refers to the different types of data collected in big data environments. 'Veracity' represents the reliability of data sources. Finally, 'value' represents the transactional, strategic, and informational benefits of big data
Abbasi et al. (2016)	Big data differs from 'regular' data along four dimensions, or '4 Vs'— volume, velocity, variety, and veracity

Source: adapted from Mikakef et al. (2018)

Under the context of this research, big data analytics is seen as being the process of using advanced technologies and analytical methods to analyse large, diverse, and complex datasets. It involves tools like data mining and statistical modelling to extract meaningful insights, aiming to improve firm performance and facilitate developments in artificial intelligence and business intelligence. Big data analytics' scope includes descriptive, predictive, and prescriptive analytics to provide actionable results that enhance organizational performance. Additionally, Table 3 presents various definitions of BDA as identified in the literature, highlighting the concept's multifaceted nature.

The advancement of technology has significantly pushed forward the development of big data analytics, introducing new data sources and broadening the scope of achievable objectives. Table 4 delineates this evolution within the management domain. Initially, big data analytics primarily focused on analysing stored data to derive economic and marketing insights. Subsequently, the expansion of internet usage introduced social media as a novel data source, infusing a relational dimension into analytics objectives. Lastly, the surge in mobile device usage further broadened the data landscape, extending the objectives to encompass social and political dimensions (Troisi et al., 2020).

Table 3: Definitions of Big Data Analytics

Authors (s) and year	Definition
Loebbecke & Picot (2015)	Big data analytics: a means to analyze and interpret any kind of digital information. Technical and analytical advancements in BDA, which—in large part—determine the functional scope of today's digital products and services, are crucial for the development of sophisticated artificial intelligence, cognitive computing capabilities, and business intelligence
Kwon et al. (2014)	Big data analytics: technologies (e.g. database and data mining tools) and techniques (e.g. analytical methods) that a company can employ to analyze large-scale, complex data for various applications intended to augment firm performance in various dimensions
Ghasemaghaei et al. (2015)	Big data analytics, defined as tools and processes often applied to large and disperse datasets for obtaining meaningful insights, has received much attention in IS research given its capacity to improve organizational performance
Lamba & Dubey (2015)	Big data analytics is defined as the application of multiple analytic methods that address the diversity of big data to provide actionable descriptive, predictive, and prescriptive results
Müller et al. (2016)	Big data analytics: the statistical modeling of large, diverse, and dynamic datasets of user-generated content and digital traces
Côrte-real et al. 2017	Big data analytics is defined as consisting of a new generation of technologies of architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling high velocity capture, discovery and/or analysis

Source: adapted and expanded from Mikalef et al. (2018)

Table 4: The Evolution of Big Data Analytics in Management

Evolution phase	Main goals	Main tools	Objectives realized
Data-base centered analytics	To store data from users and to gain insights on their behaviors	Query, online analytical processing, data mining, reporting tools dashboard and visualization	Economic and marketing
Web-based analytics	To collect opinion from users and to provide users with the possibility to express opinion	Web analytics and social media analytics Cloud computing systems	Economic and relational
Mobile-based analytics	To connect social spheres and to increase user's and citizen's engagement toward the creation of smart systems	Mobile devices and applications Sensors (RFID, barcodes, radio tags)	Economic, social and political

Source: Troisi et al. (2020)

Operationalizing big data analytics involves a comprehensive data analysis life cycle, encompassing eight critical steps: data collection; data organization; data extraction; data integration; data analysis; data sharing; data storage; and data reuse (Troisi et al., 2020; Gandomi & Haider, 2015). These steps are illustrated in Table 5, alongside the primary management processes. Ensuring the effective execution of these steps is seen as being essential for realizing the value from big data analytics implementation. Moreover, extracting this value necessitates the harmonization of these steps with traditional management processes (Troisi et al., 2020). Which enforces the need to understand how companies should organize to ensure these steps are properly addressed.

Table 5: Main Steps of Big Data Management

Main data analysis steps	Main management steps
Data collection	Establishment and sharing of a cohesive data-oriented culture
Data organization	Selection of an integrated set of analytics in line with strategic goals
Data extraction	Adequate technological infrastructure
Data integration	Computing skills
Data analysis	Analysis and research skills. Management's ability to interpret results in line with strategic goals and to catch opportunities
Data sharing	Data report and diffusion
Data storage	Feedback collection
Data reuse	Renewal of the knowledge acquired for continuous improvement

Source: Troisi et al. (2020)

Big data analytics is recognized in the literature as being closely associated with a data-oriented mindset, requiring a culture that prioritizes data collection and organization (Troisi et al., 2020). Moreover, big data analytics plays a critical role in facilitating complex business decision-making processes (Hagel, 2015), contributing to improvements in both efficiency and effectiveness (Wamba et al., 2017). Consequently, big data analytics is perceived as a key differentiator between high-performing and low-performing organizations (Liu, 2014). The practical impacts of big data analytics extend across various industries, including: retail, where it supports customer experience enhancement, fraud reduction, and provision of recommendations (Wamba et al., 2017); healthcare, contributing to operational cost reduction and quality of life improvement (Liu, 2014); manufacturing, enabling monitoring of assets and business processes (Davenport et al., 2012); and supply-chain, where it enhances automation (Wamba et al., 2017).

Big Data Analytics Capability (BDAC) is recognized in academical literature for its transformative impact on business practices and strategies. This impact encompasses several dimensions: revolutionizing firm operations (Barton & Court, 2012; Davenport,

2006), driving innovation (Gobble, 2013), representing a new (fourth) science paradigm (Strawn, 2012), initiating a management revolution (McAfee et al., 2012), emerging as a new paradigm of knowledge assets (Hagstrom, 2012), and possessing the potential to transform both theoretical and practical approaches (George et al., 2014). Consequently, BDAC has become a focal point for increasing organizational investment, being viewed as a key driver for sustained competitive advantage (Akter et al., 2016).

Laying on resource-based view, BDAC is conceptualized as a capability enabling firms to: set optimal prices; enhance quality problem detection; optimize inventory levels; and categorize clients based on loyalty and profitability in a big data context (Davenport, 2006). Additional definitions from literature are summarized in Table 6. Orlikowski (2007) expands this understanding through a sociomaterialism lens, positing that BDAC encompasses three intertwined dimensions: management, technology, and human. This perspective emphasizes the inseparability of social and material aspects in organizational research. Akter et al. (2016) further suggests that to harness BDAC for efficiency, effectiveness, and sustained competitive advantages, these three dimensions must be harmoniously integrated. Therefore, applying this theoretical perspective is expected to enrich the study of BDAC (Akter et al., 2016).

Table 6: Definitions of Big Data Analytics Capability

Authors (s) and year	Definition
Davenport & Harris (2007)	BDA capability is defined as the distinctive capability of firms in setting the optimal price, detecting quality problems, deciding the lowest possible level of inventory, or identifying loyal and profitable customers in big data environments
Cao & Duan (2014)	Information processing capabilities: an organization's capacity to capture, integrate, and analyze big data, and utilize insights derived from that big data to make informed decisions that generate real business value
Xu & Kim (2014)	Business intelligence capabilities: a combination of a set of sub-capabilities. Derived from IT capabilities, we define business intelligence capabilities from the perspectives of infrastructures, skills, execution, and relationship
Olszak (2014)	Dynamic business intelligence capability is the ability of an organization to integrate, build, and reconfigure the information resources, as well as business processes, to address rapidly changing environments
Kung et al. (2015)	Big data competence: a firm's ability to acquire, store, process, and analyze large amounts of data in various forms, and deliver information to users that allows organizations to extract value from big data in a timely fashion Big data resources are defined as a combination of complementary IT resources relevant to the utilization of big data to enhance firm performance
Garmaki et al. (2016)	The BDA capability entails a firm's ability to mobilize and deploy BDA resources effectively, utilize BDA resources, and align BDA planning with firm strategy to gain competitive advantage and enhance firm performance
Shuradze & Wagner (2016)	A data analytics capability can be defined as an organization's ability to mobilize and deploy data analytics-related resources in combination with marketing resources and capabilities, which constitutes an innovative IT capability that can improve firm performance
Gupta & George (2016)	BDA capability is defined as a firm's ability to assemble, integrate, and deploy its big data-specific resources

Source: Mikalef et al. (2018)

In the literature, there is an emphasis on strategic-led BDAC, which refers to analytics that generate sustainable business value (Wixom et al., 2013). Consistent with this perspective, BDAC is characterized as the ability to utilize big data in decision-making processes that are aligned with a firm's business strategy (Lavalle et al., 2011). Furthermore, it is identified as means to achieve competitive advantages and differentiation through real-time data analysis (Schroeck et al., 2012), and as a factor that contributes to competitive advantages when there is an alignment between organizational strategy and BDAC (Kiron et al., 2014).

Akter et al. (2016) sustains that BDAC is composed by three main building blocks, which are organizational, physical, and human. According to this author the capabilities related with the referred building blocks contribute to forming BDAC. Going through those blocks: the organizational dimension is intrinsically related with management capabilities, which when related with BDAC, assures that a proper management framework sustains business decisions. Technological capabilities in this scope refer to the flexibility of the BDA platform, which in turn is related with providing to data scientists the capacity to develop, deploy and support solutions. Talent capability in refer to the ability that analytics professionals have to perform their tasks in a big data environment, leading to sustainable creation of competitive advantages (Constantiou & Kallinikos, 2015).

In a more recent work, Keshavarz et al. (2021) proposed the inclusion of two new dimensions: domain knowledge and innovation. The domain knowledge capability pertains to the critical importance of having specific knowledge in a given domain to effectively meet and deliver business needs. This dimension can arguably be aligned with the previously defined BDA talent capability, or be assured through multidisciplinary collaboration. The innovation capability refers to a firm's capacity for continuous development in response to its surrounding environment (Olsson et al., 2010), whether through incremental or disruptive changes. However, it is debatable whether innovation acts more as a consequence than as an antecedent in this context. Thus, this research was guided by Akter's et al. (2016) view that argues that BDAC is composed by three building

blocks (i.e., organizational, physical, and human). Furthermore, the followed definition of BDAC encompasses the concept of Advanced Analytics, which goes beyond traditional analytics solutions by incorporate algorithmic techniques from machine learning, artificial intelligence, natural language processing and other computer science disciplines (Rose *et al*, 2012).

As is also seen in the literature, BDAC is often fundamentally intertwined with decision-making processes, particularly those that are considered data-driven (Lavalle et al., 2011). The term data-driven refers to the practice of utilizing data to substantiate decisions (Kavitha & Chinnasamy, 2021). Given this interaction, BDAC is often portrayed in academic literature as a catalyst for enhancing data-driven decision-making capabilities (Yiu, 2012).

2.4 Data Democratization

The concept of Data Democratization is closely intertwined with BDAC. It is defined as the practice of making organizational data accessible to a wide range of employees, regardless of their technical or specialist backgrounds, while ensuring compliance with legal confidentiality and security constraints (Awasthi & George, 2020). This concept can be argued to be an extension of the previously presented data sharing stage (Troisi et al., 2020) further expanding it. In this context, BDAC solutions can be tailored to either directly provide data to employees or indirectly contribute to other systems that employees use. Table 2 presents various definitions of Data Democratization found in literature, covering both IS/IT and broader contexts.

To enable a better a better understanding of Data Democratization, Lefebvre et al. (2021) identified five critical enablers of Data Democratization: (1) Broader data access, emphasizing the need for data catalogues and internal data sharing, sometimes extending to external sharing; (2) Self-service analytics tools, such as BI/reporting tools and broader platforms; (3) Development of data and analytics skills, highlighting the importance of internal training and data literacy; (4) Collaboration and knowledge sharing, leading to

the formation of data communities and closer collaboration between technical specialists and business users; and (5) Promotion of data value, which involves integrating data value into company values and promoting its benefits.

Table 7: Definitions of Data Democracy

Field	Authors (s) and year	Definition
IS/IT	Awasthi & George (2020)	Defined as being the act of opening organizational data to as many employees as possible, given reasonable limitations on legal confidentiality and security
IS/IT	Hyun et al. (2020)	Presented as being the organizational culture that values the willingness to share information and the acceptance of diversity
IS/IT	Labadie et al. (2020)	Introduced as being the process of empowering a group of users – not just data experts – to find, access, and use data by removing obstacles to data exploration and sharing in enterprises
Non-IS/IT	Treuhaft (2006)	Presented as enabling community actors to access data and to use it to build community capacity to effect social change
Non-IS/IT	Bellin et al. (2010)	Defined as being the ability of users to access all data using well-defined and easily used analytic patterns to answer unexpected questions without requiring preauthorization or special additional resources

Source: Lefebvre et al. (2021)

In enhancing the understanding of Data Democratization, Samarasinghe & Lokuge (2022) identified its critical success factors. These include: (1) Data Management Policies and Practices favouring democratization by removing data silos and ensuring data accuracy; (2) A Data Sharing Culture that fosters the willingness to share data and encourages multidisciplinary collaboration; (3) Data Management Trainings, particularly

for non-technical experts to reduce reliance on specialists and accelerate data-driven decision-making; (4) Top Management Support, emphasizing the need for leadership to endorse and adopt a data-driven mindset; (5) Availability and Access to Analytical Tools, empowering data consumers to conduct their own analysis; (6) An Organizational Vision and Plan aligning data democratization with core strategic objectives; (7) Employee Willingness to Collaborate and Share Data, promoting interdepartmental cooperation and analysis output sharing; (8) Establishment of Data Security and Privacy to uphold data governance and security standards; and (9) Shared Responsibility over Organizational Data, where data ownership is a collective duty of the organization and its data consumers.

It is therefore anticipated that data democracy can play a pivotal role in this thesis, specifically in the examination of how business benefits are derived from BDAC. In essence, data democratization is expected to act as an enabler, fostering an environment where BDAC can be more effectively utilized to yield both tangible and intangible business benefits.

2.5 Business Benefits of BDAC

Research on the business benefits of BDAC remains limited, particularly from a benefits management perspective (Jensen et al., 2023). A notable exception is the study by Jensen et al. (2023), which, while primarily concentrating on the benefits management process rather than the direct business benefits and their realization, identifies several key business benefits. These include scalability, automation, reduction of resource expenditure, decreased response times, and an improvement in the contribution margin by a specified percentage.

Extending the analysis beyond the confines of a benefits management framework, literature identifies various high-level benefits associated with BDAC. Particularly, in the manufacturing sector, BDAC facilitates modern predictive maintenance, yielding significant benefits such as: (1) waste minimization, (2) diminished human error, and the (3) enhanced production of higher quality products at an accelerated rate (Shahid &

Sheikh, 2021). Within this broader scope, an insightful contribution by Cohen (2015) demonstrated that integrating production systems with those of their partners can further amplify BDAC benefits.

BDAC within the healthcare sector has been identified as facilitating a range of significant benefits. These include (1) enhancing early diagnosis and the effectiveness and quality of treatments through the discovery of early signals and timely disease intervention, thereby reducing the likelihood of adverse reactions; (2) expanding the potential for disease prevention via the identification of risk factors; (3) augmenting pharmacovigilance and patient safety by enabling more informed medical decisions through direct information delivery to patients; and (4) predicting patient outcomes (Pastorino et al., 2019). Although the healthcare sector markedly differs from the industries examined in our research, these benefits remain pertinent as they embody enhancements in both efficiency and effectiveness. This relevance is further evidenced in Table 8, which summarizes findings from Wang et al. (2018), also within the healthcare context.

In supply chains, these technologies foster greater efficiency through advancements such as defect tracking, enhancement of product quality assurance, and improvements within the manufacturing process itself (Wang & Alexander, 2015). Furthermore, existing literature identified benefits in areas including research and development (R&D), product and services development, process improvements, marketing (Shahid & Sheikh, 2021), customer relationship management, supply chain optimization, risk management, and fraud detection (Elgendy & Elragal, 2014). These benefits derived from BDAC are not confined to any single industry, with applications spanning sectors such as government, healthcare, telecommunications, and banking (Elgendy & Elragal, 2014; Dinh et al., 2020).

Table 8: Benefits Driven by Big Data Analytics

Benefits Category	Element
IT infrastructure benefits	Reduce system redundancy
	Avoid unnecessary IT costs
	Transfer data quickly among healthcare IT systems
	Better use of healthcare systems
	Process standardization among various healthcare IT systems
	Reduce IT maintenance costs regarding data storage
Operational benefits	Improve the quality and accuracy of clinical decisions
	Process a large number of health records in seconds
	Reduce the time of patient travel
	Immediate access to clinical data to analyze
	Shorten the time of diagnostic test
	Reductions in surgery-related hospitalizations
	Explore inconceivable new research avenues
Organizational benefits	Detect interoperability problems much more quickly than traditional manual methods
	Improve cross-functional communication and collaboration among administrative staffs, researchers, clinicians and IT staffs
	Enable to share data with other institutions and add new services, content sources and research partners
Managerial benefits	Gain insights quickly about changing healthcare trends in the market
	Provide members of the board and heads of department with sound decision-support information on the daily clinical setting
	Optimization of business growth-related decisions
Strategic benefits	Provide a big picture view of treatment delivery for meeting future need
	Create high competitive healthcare services

Source: adapted from Wang et al. (2018)

With an extensive approach, BDAC has been identified as supporting benefits related to cost reduction, enhanced decision-making speed and quality, innovation in products and services, product recommendations, fraud detection (Balachandran & Prasad, 2017),

and improved performance (Alyahya et al., 2023). The connection between BDAC-enabled benefits and efficiency underscores how these capabilities facilitate cost reductions, especially as they are increasingly used for process automation. Recent research indicates that while BDAC leads to cost savings these capabilities also ensure more accurate results (Dinh et al., 2018).

Moreover, the influence of BDAC on decision-making is a prominent topic in the literature. It is recognized for enabling more informed decision-making processes (Pareek & Gupta, 2012; Balachandran & Prasad, 2017), with decision-making activities benefiting from time efficiencies and enhanced effectiveness (Shahid & Sheikh, 2021). Thus, the use of BDAC in decision support is viewed as a critical contributor to organizational economic value (Verma et al., 2018).

These capabilities also enable benefits to the development of new products and services, providing essential information that facilitates these initiatives. Initially more prevalent within online companies, where collecting customer behavior data is more straightforward. Under online settings, BDAC enhances product recommendation systems, enabling efficient handling of large datasets and fostering a more profitable strategy (Balachandran & Prasad, 2017). Furthermore, offline companies are also similarly leveraging BDAC to achieve comparable benefits (Balachandran & Prasad, 2017)

Fraud detection benefits significantly from BDAC that offers flexible and scalable real-time solutions at a reasonable cost, particularly altering the way insurance companies manage data to combat fraud (Balachandran & Prasad, 2017). These capabilities were found to allow the identification of fraud networks and the uncovering of fraudulent insurance claims (Verma et al., 2018).

Finally, BDAC was also found to be linked with sustainable performance – encompassing environmental, economic, and social dimensions – as a direct outcome of strategic agility enhancement. Additionally, firm creativity is recognized as exerting a moderating influence on this relationship, with a notable correlation to the firm's ability

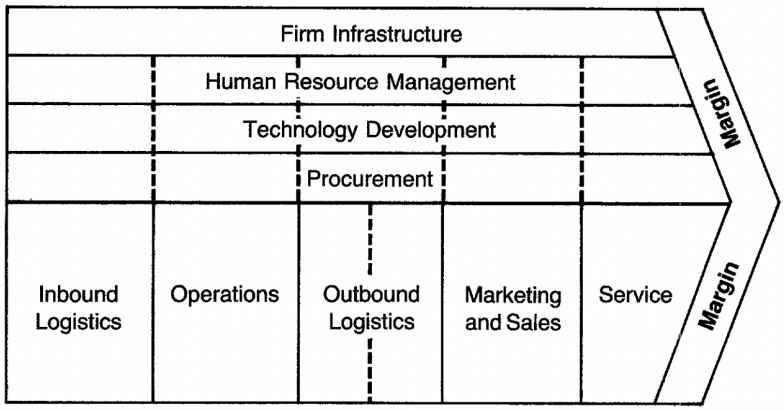
to innovate and adapt by reconfiguring management practices and resources, including the acquisition of new talent (Alyahya et al., 2023).

In the literature that address BDAC enablement of business benefits, these capabilities have been identified as a source of competitive advantage, offering valuable insights (Sagiroglu & Sinanc, 2013) and increasingly having a disruptive effect on established industries and business models (Shahid & Sheikh, 2021). Still, it is worth stressing out the lack the current lack of focus on benefits realization.

2.6 Organizational Framing

This research is dedicated to exploring the benefits enabled by BDAC across various business activities. To this end, Porter's value chain model (Porter, 1985) is employed as a foundational framework. Porter proposes that organizations generate value through a series of interconnected primary and support activities (see Figure 5). Expanding upon this, Porter (2001) later demonstrated the integral role of internet-based technologies in augmenting the value chain. This evolution underscores the adaptability of the framework to encompass the analysis of organizational activities influenced by contemporary technologies, including those derived from BDAC.

Figure 5 – Enterprise Value Chain



Source: Porter (1985)

According to Porter's value chain framework (1985), organizations engage in two distinct categories of activities that contribute to value creation. The first category encompasses primary activities, which include processes directly involved in the creation, marketing, delivery, and after-sales support of products or services. These processes comprise inbound logistics, operations, outbound logistics, marketing and sales, and service. The second category pertains to support activities, which provide essential inputs and assistance to the primary activities. This category includes procurement, technology development, human resource management, and firm infrastructure.

Bedeley et al. (2018) used Porter's value chain framework to examine the deployment of business analytics techniques and tools within various value chain activities, including the identification of benefits resulting from such applications. Their findings suggest a predominant utilization of analytics capabilities within primary activities compared to support activities. However, given the constraints of their sample data, the authors advocate for further empirical research to deepen the understanding of analytics usage within firms' value chains. Echoing Bedeley et al.'s (2018) insights, the research presented in this thesis, constrained by collaboration limitations, similarly emphasizes primary activities. Namely operations and sales and marketing and sales, often referred to as commercial throughout this document.

Another concept of relevance to this research, which aims to deepen the understanding of how companies organize teams for big data analytics capabilities, involves the organizational decisions regarding centralization and decentralization. Although not extensively explored within the literature on BDAC, these concepts are relevant for this study to support reaching a better understanding on how companies are organized to benefit from BDAC. Centralization has been recognized as a significant factor in organizational efficiency (Fan et al., 2022), yet there is a growing contention that technological advancements increasingly support a shift towards decentralization within firms (Acemoglu, 2007).

Centralization pertains to the extent of centralized or distributed authority within an organization, characterized by the concentration of power and autonomy at the upper

hierarchical levels (Away et al., 2021). It is pertinent to acknowledge that centralization's impact on firm performance has been reported as both positive and negative (Rasch & Wambach, 2009). Furthermore, centralization may have a negative impact on timely responses to customer demands due to the hierarchical decision-making process, requiring decisions to ascend the organizational ladder (Away et al., 2021).

Decentralization, in contrast, involves distributing decision-making authority to lower hierarchical levels within organizations, a strategy regarded as enhancing overall efficiency (Away et al., 2021). This approach has been associated with faster decision-making, increased innovation, and improved responsiveness to customer needs. However, it requires a workforce with higher capabilities compared to centralization, where decision-making is predominantly centralized are made by fewer people (Away et al., 2021).

Chapter III – Research Methodology

This chapter is structured into three main sections. The initial section delves into the philosophical underpinnings of the study, encompassing discussions on ontology, epistemology, and the research paradigm. Following this, the chapter outlines the research strategy, with a particular emphasis on the adoption of a case study approach. Lastly, the research design is detailed, ensuring thorough communication of the data collection and analysis procedures to provide methodological transparency regarding the implemented steps.

3.1 Philosophical Perspectives

The research developed required decisions regarding the research strategy and methodological approach, underpinned by philosophical perspectives. Research philosophy "refers to a system of beliefs and assumptions about the development of knowledge" (Saunders et al., 2019, p. 130). Guba & Lincoln (1994) contend that these beliefs are articulated through responses to three key questions: (1) "What is the form and nature of reality and, therefore, what is there that can be known about it?" (addressing ontology); (2) "What is the nature of the relationship between the knower or would-be knower and what can be known?" (addressing epistemology), and (3) "How can the inquirer (would-be knower) go about finding out whatever he or she believes can be known?" (outlining the research strategy).

Addressing these considerations is crucial for establishing the research's ontological and epistemological stance, which this section aims to elucidate, also by presenting different research paradigms and identifying the one adopted by this research. As for research strategy, it will be addressed in the next section of this chapter.

Ontology

Starting with ontology, which examines the nature of reality, this thesis follows the fundamental debate between objectivism and subjectivism opposite views to clarify the concept. Objectivism asserts the existence of an objective reality that is external and independent of social actors (Saunders et al., 2019). Opposingly, subjectivism posits that reality is constructed through the perceptions and interactions of social actors, suggesting that these perceptions and actions are mutually shaped by engagements with other individuals within the social sphere (Saunders et al., 2019). While these are extreme views, this research follows a more moderate view of the nature of reality as we will further discuss while addressing the research paradigm.

Epistemology

As for epistemology, that concerns what is considered acceptable knowledge in a field of study, its clarification can be founded contrasting positivism and interpretivism. Positivism asserts that legitimate knowledge is exclusively derived from observable phenomena and logical reasoning. This approach advocates for hypothesis testing to either confirm or refute propositions, aiming to establish law-like generalizations as the aim of scientific research (Saunders et al., 2019). Opposingly, interpretivism defends that in social sciences, the intricacies of human experiences block the possibility of universal generalizations. Instead, interpretivism emphasizes the importance of understanding social phenomena through the subjective interpretation of individuals, arguing that research should explore the nuanced interpretative processes individuals employ to navigate and make sense of their world (Saunders et al., 2019). This research positioning regarding epistemology will be introduced in the following section.

Research Paradigm

The concepts of research paradigms and research philosophies are often intertwined and can be confusing due to their similarity and occasional interchangeable use (Saunders et al., 2019). However, a research paradigm is generally considered both a broader concept and more practical in application compared to research philosophies (Guba & Lincoln, 1994). Essentially, a research paradigm is shaped by the chosen ontological and epistemological positions. To aid in understanding, Table 9 contrasts three prevalent research paradigms in management research: positivism, interpretivism, and critical realism (Saunders et al., 2019), which will be succinctly discussed in the subsequently.

Table 9: Research Paradigms Comparison

	Positivism	Interpretivism	Critical Realism
Ontology	Objective reality, unproblematically apprehended	Reality socially constructed by humans via subjective meanings, symbolic action, and social politics	Objective, stratified reality (consisting of structures, mechanisms and events), but imperfectly and fallibly apprehended
Epistemology	Empirical testing and verification of predictive theories via hypothetical deductive methods; findings assumed true until falsified	Knowledge generated by understanding the meanings and actions or subjects; findings "created" by researcher based on this understanding	Knowledge retroduced to theories regarding underlying reality which explain observable events; findings probably true, but mediated by humans

Source: adapted from Wynn & Williams (2008)

Positivism, as defined by Hirschheim (1985), views the world as observable and quantifiable, advocating for the identification of universal laws through empirical testing. This paradigm is grounded in the belief that reality is singular and subject to universal principles, thus promoting a value-neutral approach where researchers remain detached from the subject of their study (Saunders et al., 2019). According to Orlikowski & Baroudi (1991), positivism typically employs a deductive approach to theory development, prioritizing the establishment of cause-effect relationships that are presumed to exist independently of the observer. Consequently, research within this paradigm seeks to uncover universal laws that govern phenomena, ensuring objectivity and replicability (Lee & Baskerville, 2003).

Interpretivism posits that individuals, including researchers, construct their own subjective realities through interactions with the world (Orlikowski & Baroudi, 1991). This paradigm argues that reality is socially constructed, offering multiple interpretations

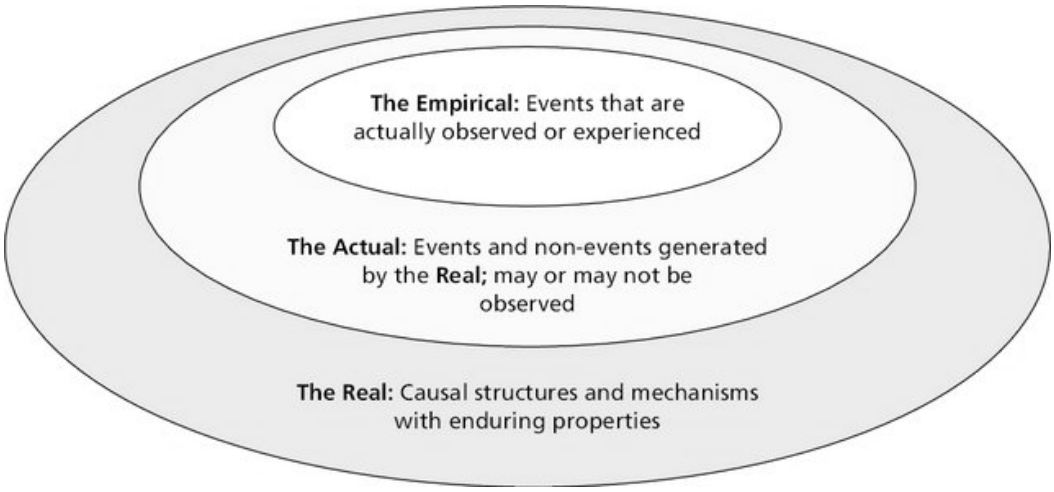
influenced by the observer's perceptions (Saunders et al., 2019). In this view, the researcher's interpretations are key in contributing new understandings and perspectives. Interpretivism typically favours an inductive approach, aligning more closely with qualitative research methods to uncover the nuanced complexities of social phenomena (Saunders et al., 2019).

Realism assumes that the world exists regardless of our awareness of it. Saunders et al. (2019) caution not to confuse two types of realism, direct realism, which suggests our sensory perceptions accurately reflect the world, with critical realism which views reality as objective yet stratified. Critical realism argues that understanding is reached through two steps: first, the sensory experiences and events we encounter; second, the cognitive processes that interpret these experiences. Critical realism employs abductive reasoning, working backward from observed phenomena to infer the underlying structures and mechanisms that may have caused them (Wynn & Williams, 2008; Saunders et al., 2019). This paradigm acknowledges the complexity of interpreting the real world, advocating for a methodological approach that seeks to uncover the deeper, often hidden, layers of reality.

Critical realism adopts a stratified ontological perspective (Saunders et al., 2019), and can be visualized through a three-layered model (Figure 6): (1) Empirical, this foundational layer encompasses direct observations, data collection, and sensory experiences. It relates to the phenomena that researchers can measure, observe, and quantify, representing the surface-level experiences accessible to empirical inquiry. (2) Actual, at this intermediate layer, the focus extends to events that transpire in reality, inclusive of those beyond direct observation. It captures the totality of phenomena within the realm of existence, acknowledging the occurrence of events regardless of human detection or awareness. (3) Real, the deepest layer probes into the underlying mechanisms and structural entities that precipitate the phenomena observable at the empirical and actual levels. It is dedicated to uncovering the intrinsic causal powers and generative mechanisms that operate independently of human perception, aiming to elucidate the fundamental reasons behind observable events. This research adopts a critical realism

paradigm and by doing so it aims to navigate beyond superficial observations, striving to reach an understanding of the underlying mechanisms that govern the benefits derived from big data analytics capabilities within organizations.

Figure 6 – Critical Realism Stratified Ontology



Source: Saunders et al. (2019) adapted from Bhaskar (2008)

3.2 Research Strategy

In contemplating the approach to theory development, it can be argued that achieving pure deduction or pure induction is often impractical (Saunders et al., 2019). Consequently, this research adopts an abductive approach, characterized by a dynamic movement between theory and data. It is noteworthy that abduction, sometimes referred to as retroduction, is particularly acknowledged for its applicability in case study research, which aligns with the methodology of this study (Saunders et al., 2019).

The selection of a research strategy is informed by the research's objectives, the nature of the problem being investigated, the questions posed, and the researcher's philosophical stance (Saunders et al., 2019). Given this study's aim to elucidate how companies leverage big data analytics capabilities for realizing benefits, a case study

methodology is employed. This approach is suited for exploring "how" questions, facilitating a deeper understanding of the phenomena under investigation (Yin, 2018).

Case Study

The case study methodology offers an empirical approach enabling an in-depth investigation of contemporary phenomena within their real-life contexts, especially valuable when the boundaries between phenomenon and context are fuzzy (Yin, 2018). Moreover, Benbasat et al. (1987) outline three compelling reasons for the viability of case study research in IS: (1) it permits the exploration of information systems within their natural settings, fostering an understanding of current practices and theory generation; (2) it facilitates addressing 'how' and 'why' questions, thereby unravelling the complexities of underlying processes; and (3) it is particularly suited for fields where prior research is sparse. These three reasons align with the objectives of this research: knowledge is to be generated from practical settings, the research questions are framed as 'how' questions, and, as identified in the previous chapter, there is a notable gap in research concerning this phenomenon from a benefits management perspective.

Reinforcing the choice, Yin (2018) identifies three critical factors in determining an appropriate research strategy: the nature of the research question, the control over behavioural events, and the focus on contemporary phenomena. Given that this study addresses 'how' questions within the context of current events without necessitating control over behavioural dynamics, the case study methodology is deemed appropriate, aligning with all three factors. Table 10 illustrates the support for research method decisions based on the three criteria identified by Yin (2018).

Table 10: Relevant Situations for Different Research Methods

Method	Form of research question	Requires control over behavioral events?	Focuses on contemporary events?
Experiment	How, why?	yes	yes
Survey	who, what, where, how many, how much?	no	yes
Archival Analysis	who, what, where, how many, how much?	no	yes/no
History	how, why?	no	no
Case Study	how, why?	no	yes

Source: Yin (2018)

The selection of case study research as the methodological approach for this research is further justified by its capacity to facilitate a nuanced exploration of big data analytics capabilities within the operational contexts of companies. Investigating this phenomenon necessitates an in-depth understanding of complex social phenomena, which is particularly pertinent when examining the Enabling Changes and Business Changes components of the Benefits Dependency Network (Ward & Daniel, 2012). These components are crucial for understanding organizational processes and their transformation. According to Yin (2018), the case study methodology enables researchers to preserve the holistic and meaningful characteristics of real-life events, such as organizational processes, thereby providing a rich, contextual analysis that aligns with the objectives of this research.

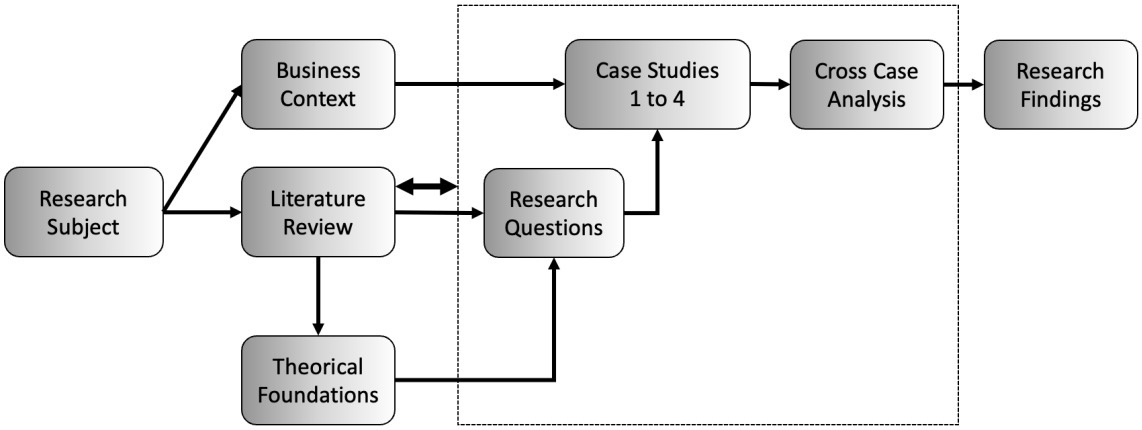
Yin (2018) emphasizes that the simplicity of case study research is often overestimated. In alignment with the rigorous preparation required for this research, several of the author's recommendations are integrated, including: protecting human subjects, where ethical considerations are prioritized from the outset, particularly ensuring anonymity of all the participants; and the formulation of a case study protocol,

which is crucial for structuring the case studies, especially given that the research encompasses multiple case studies. The protocol as shared with individuals that provided access for this research and was clearly communicated to all the participants.

3.3 Research Design

Yin (2018) defines a research design as a logical plan that guides the transition from "here" (research questions) to "there" (the answers we aim to achieve). This transition encapsulates the essence of the research process. Figure 7, which will be elaborated upon subsequently, delineates the research design adopted for this thesis, illustrating the methodological pathway from posing research questions to deriving conclusions.

Figure 7 – Research Design



This research was enabled by a research subject and then founded in an extensive literature review and an examination of the business context surrounding companies operating in the Portuguese market. The literature review provided a comprehensive understanding of the current state of knowledge regarding the phenomenon, informing the formulation of research questions and guiding the selection of theoretical frameworks for adaptation. Additionally, preliminary observations of these companies revealed investment patterns related to BDAC, which then supported the decision on which companies to focus for achieving collaboration. Also, the companies' location in Portugal was a crucial factor to ensure facilitated access.

The design adopted aligns with the components identified by Yin (2018) as most pertinent: (1) A case study's questions – crucial at this stage was the outcome of the literature review, which enabled a clear and more relevant definition of the research questions. These questions served as the starting point for the development of the case studies; (2) Propositions – also originated from the literature review, which was relevant to articulate propositions. These propositions guided the case studies in a coherent direction, facilitating a more targeted search for information and evidence; (3) Cases – defining the cases studied is a critical aspect of the research design. This definition was built upon the questions and propositions previously identified, ensuring a focused and effective investigation.

This research encompasses four case studies. The decision to include multiple case studies was motivated by the inherent advantage that evidence derived from this approach is often considered more compelling and, therefore, more robust (Herriott & Firestone, 1983). A replication logic was adopted, ensuring a consistent approach across cases (Yin, 2018), despite the selected companies operating in diverse industries. Furthermore, this design supports the possibility of theoretical generalization beyond industry specifics. Based on the preliminary context, a collaboration protocol was established with leading companies in their respective industries within Portugal. The case studies were conducted according to a timeline that occasionally overlapped. The first case, while not differing from the subsequent cases, was started significantly before to act as a validation of the design's effectiveness in addressing the identified research questions, and as it considered valid the subsequent cases were conducted as direct replications.

In the subsequent two sections, we will explore the methodological decisions related to data collection and analysis, which are integral to the remaining aspects of our research design. This includes both within and cross-case analyses, as well as the derivation of research findings from the data analysis process.

Data Collection

Data collection was conducted through interviews with individuals in management roles associated with commercial and operational activities that were either directly influenced by or supported by BDAC (Appendix A). Additionally, managers responsible for IS/IT functions, or specifically Data activities when distinct from IS/IT, were also interviewed. Saunders et al. (2019) categorize interviews into three groups based on their level of formality and structure: structured, semi-structured, and unstructured interviews. This research employed semi-structured interviews. According to Saunders et al. (2019), semi-structured, non-standardized (qualitative) interviews are particularly suitable for explanatory studies, as they enable the researcher to infer causal relationships between variables. The non-standardized nature of these interviews allowed the researcher to delve deeper into participants' responses, although the initial question had some theorical guidance provided by the literature review, which is coherent with the abductive research approach.

The agreements with the participating companies' top management facilitated the involvement of multiple individuals from each organization, which was crucial for enabling triangulation. Triangulation, as described by Saunders et al. (2019), involves using multiple data sources and collection methods to validate the research findings. Patton (2015) identifies four types of triangulation: (1) of data sources (data triangulation); (2) among different evaluators (investigator triangulation), (3) of perspectives of the same data set (theory triangulation), and (4) of methods (methodological triangulation). This study primarily employed data source triangulation both within case and cross case.

Interviews, each limited to one hour, were conducted using a script. This script ensured interviewees were informed about the interview's purpose, the confidentiality of their identities, and that consent for recording was obtained. The decision to record interviews, guided by Saunders et al. (2019) and for convenience, leveraged technology to facilitate transcript generation. However, the accuracy of these automated transcripts required validation, a time-consuming yet efficiency-contributing process. Interviews

conducted in Portuguese were translated to English using advanced language models (ChatGPT), ensuring accuracy and comprehensibility in this document.

Furthermore, the interview script incorporated themes identified in the literature review and Level 2 questions related to these themes. Following the categorization, presented in Table 11, Yin (2018) highlights the distinction between Level 1 and Level 2 questions, with Level 2 questions acting as underlying considerations not necessarily verbalized as direct questions (Level 1). Given the varied profiles of the participants, two distinct scripts were developed: one for participants involved in primary activities, such as commercial and operations, and another for those responsible for IS/IT and data domains. The interview guide is available in Appendix B.

Table 11: Five Level of Questions

LEVEL 1	Questions verbalized to specific interviewees
LEVEL 2	Questions about each case, which represent your line of inquiry, as just discussed
LEVEL 3	Questions asked of the pattern of findings across multiple cases
LEVEL 4	Questions asked of an entire study – calling on information beyond the case study evidence and including other literature or published data that may have been reviewed
LEVEL 5	Normative questions about policy recommendations and conclusions, going beyond the narrow scope of the study

Source: adapted from Yin (2018)

This research involved conducting twenty one-to-one, semi-structured interviews with twenty participants. According to Saunders et al. (2019), one-to-one interviews can be conducted face-to-face, via telephone, or through internet platforms. In this study, all interviews were carried out over the internet using Microsoft Teams, a decision that facilitated the recording process and enabled the automatic generation of transcripts as previously mentioned.

Additionally, there was an intention to utilize secondary data, which, according to Saunders et al. (2019), can often serve as a valuable source to answer research questions, at least in part. Despite this intent, the companies involved in the study did not provide access to such data justified by the fact BDAC is considered a source of competitive advantages. Nevertheless, publicly available data was utilized both to select the companies for contact and to inform the preparation of the interviews. Which was possible due to the availability of press and media articles related to BDAC investments occurred in the participating companies.

Data Analysis

The interactive process of data collection offers researchers the opportunity to identify significant themes, patterns, and relationships, as highlighted by Saunders et al. (2019). In this study, themes, patterns, and relationships were discerned throughout the data analysis phase, informed by insights from the literature review. The analytical challenge lies in developing coherent descriptions and explanations that account for gaps, inconsistencies, and contradictions, which are inherent in personal and social life, as noted by Miles et al. (2014).

In this study, the data analysis approach is twofold. Initially, it relies on thematic analysis, a foundational method for qualitative analysis (Braun & Clarke, 2006). The primary objective of thematic analysis is to identify themes or patterns within a data set, such as those emerging from a series of interviews, highlighting its utility in qualitative research (Saunders et al., 2019). Additionally, cross-case synthesis was employed to analyse data from multiple case studies, aligning with the methodology endorsed by Yin (2018) for this type of research.

The use of thematic analysis, as outlined by Saunders et al. (2019), enables researchers to: (1) understand large and varied sets of qualitative data; (2) synthesize related data from different transcripts and notes; (3) uncover key themes or patterns within a dataset for further investigation; (4) generate a thematic description of these data; (5) develop and test theories based on identified thematic patterns or relationships; and

(6) formulate and validate conclusions (see Table 12). Bearing these objectives in mind, the individual case analyses in the following chapter were performed using thematic analysis, as also part of the analysis presented in chapter 5. Worth noting that the themes considered relevant to be included in this document were validated through triangulation of data sources.

Table 12: Usages of Thematic Analysis

1	Comprehend often large and disparate amounts of qualitative data
2	Integrate related data drawn from different transcripts and notes
3	Identify key themes or patterns from a data set for further exploration
4	Produce a thematic description of these data, and/or,
5	Develop and test explanations and theories based on apparent thematic patterns or relationships
6	Draw and verify conclusions

Source: adapted from Saunders et al. (2019)

The thematic analysis was supported by MAXQDA 24 software, which helped achieve several anticipated benefits that bolster analytical efforts. These benefits include: (1) accelerating the analysis process; (2) increasing analytical rigor; (3) enabling more versatile data analysis from various perspectives; (4) simplifying the exchange and reproduction of data; and (5) allowing researchers to delve deeper into the data by minimizing manual tasks (Oliveira et al., 2013). The coding process, integral to thematic analysis, was executed using this software. All primary data, namely interview transcripts, were coded using an abductive approach. This began with a set of codes derived deductively from the literature review, and was complemented by an inductive process as new codes emerged from the data analysis.

While the analytical foundation of this research is based on thematic analysis, the data analysis also utilized cross-case synthesis. According to Yin (2018), cross-case

synthesis is particularly pertinent in multi-case study research scenarios. Therefore, this technique was employed in the cross-analysis, adhering to the recommendations of the same author. Specifically, differences among the individual cases were carefully considered to ensure clarity in the dimensions across which they are comparable. Furthermore, the identification of cross-case patterns was grounded in argumentative interpretation. The findings resulting from the analysis using this technique are presented in Chapter 5.

The analysis sought to achieve generalizability, often referred to as external validity (Saunders et al., 2019). It is important to recognize that case study findings do not automatically generalize to broader contexts. External validity addresses the challenges of generalizing results beyond the specific case study. Yin (2018) acknowledges the common skepticism regarding the generalizability of case studies but counters this by arguing that generalization from even a single case is possible. However, it is through replication logic, i.e., the replication of results across cases, that stronger theoretical generalization can be achieved.

This research has a design that encompasses four case studies, each supported by multiple sources of evidence, aiming to facilitate analytical generalization. Yin (2018) differentiates between statistical generalization, which is less applicable to case study research and requires a distinct design, and analytical generalization. The latter is grounded in the logic of replication. If two or more cases corroborate the same theory, replication and, consequently, generalizability may be claimed (Yin, 2018). The generalizability of qualitative research is tied to its theoretical relevance. Linking the research findings to existing theory affirms their wider theoretical importance (Saunders et al., 2019), approach which has been followed in this research.

Chapter IV: Case Studies

This chapter includes the presentation and analysis of the case studies. The case studies were performed in four companies from different industries: Telecommunications, Logistics, Insurance, and Banking. The analysis of each case is grounded in thematic analysis and is presented alongside the presentation of the cases.

Each case follows a consistent structure, commencing with an introduction that informs the company's context and background. This is succeeded by a summary of the big data analytics capabilities identified, including an overview of how the companies are structured concerning these capabilities. Subsequently, an evaluation of the business benefits, based on a benefits management approach, is conducted, where the enablers and benefits presented are presented with the levels of detail the collaborations allowed, leading to some cases to be more detailed than others. This section is followed by future investment plans, a discussion centered on the prevailing themes of each case, and a conclusion that summarizes the analysis of the case.

4.1 Case Study 1 – Telco

Introduction

This case study focuses on a telecommunications operator that conducts its operations in Portugal. As one of the top three players in the industry, this operator offers both cabled and wireless telecommunications services, with its coverage extending across the majority of the Portuguese territory. The Portuguese telecommunications market is highly competitive, with penetration rates over 100%. In such an environment, the operators strategically emphasize client retention and strive to maximize profitability within their existing customer base. Moreover, these key industry players are recognized for their offer diversification efforts. They undertake significant initiatives to expand their service offerings beyond the traditional scope of telecommunications, thus aiming to reach a broader market.

Sustaining the satisfaction of their current client base and, consequently, their retention, is a key business objective pursued by this firm, an unsurprising strategical goal given the current market configuration. Other principal business objectives include financial performance and regulatory compliance. The first, a common objective, takes on heightened relevance in this context due to the level of competition. The second derives from the firm operating in a heavily regulated industry, frequently subject to strong interventions by the regulator. In subsequent sections of this document, we will delve into the BDAC established in primary activities of the company, i.e., commercial segments and operations, and examine how IS/IT function supports these endeavours, along with the benefits enabled by these capabilities.

The extensive volume of data within this context establishes an ideal environment for the development and application of BDAC. The intense degree of competition only heightens the importance of realizing benefits from such capabilities. To deepen the understanding of this phenomenon within the firm's context, and given their degree of collaboration, five collaborators with management roles were interviewed:

- The Director of the Business to Consumer (B2C) segment, subsequently referred to as the B2C Director.
- The Analytics Manager of the Business to Business (B2B) segment, subsequently referred to as the B2B Manager, who leads the analytical team within B2B segment.
- The Field Force Analytics and Support Manager, subsequently referred to as the FF Manager, who leads both the segment internal analytics team, internal support and manages IS/IT development requests.
- The Support Office Manager within Customer Operations, subsequently referred to as the Support Manager, who leads internal support functions within the segment including an analytics team.
- The Business Intelligence (BI) Manager within IS/IT, subsequently referred to as the BI Manager.

The input from these participants allowed a multidimensional view of the firm's adoption and application of BDAC specifically in operations and commercial activities.

Big Data Analytics Capabilities

The firm under study was found to possess robust big data analytics capabilities across all examined sectors of the company. Moreover, the big data supporting these capabilities consists mostly of information related with customers, products and services (P&S), equipment, and operations. The primary sources of this data are internal systems, both operational and analytical, although external sources are also mentioned to be used to enrich and increase the potential subsequent analytical value, as is the case of a weather service mentioned by the FF Manager:

"The weather service is a very important component".

Focussing internal systems, some sources consist in analytical systems currently maintained and delivered by the firm's IS/IT function. Specific instances mentioned include a corporate data warehouse associated with fixed services business, a specialized

data mart focused on mobile services business, and a corporate data lake. This last component is the result of a project that the BI Manager mentioned to be unfinished:

> *"A data lake that was half completed but is in use and has some data there that is consulted".*

While the majority of the referred data sources were internal systems, external data sources were also acknowledged as instrumental to ensure that BDAC effectively meet the intended objectives. Besides the already mentioned Field Force Operations example of usage of a third-party service providing meteorological information, which is found to be key to ensuring optimal field force capacity planning.

In the specific context of the B2B segment, external sources were found to be indispensable for enriching client-related information. Particularly providing a comprehensive 360-degree view to sales channels, as shared by the B2B Manager:

> *"By bringing in information from outside, I can greatly enrich my database".*

Both these examples of external data sources relevance are related with BDAC that can be classified as being examples of advanced analytics, although there are also applications of advanced analytics only based in internal data sources.

For both internal and external data sources, it is due of note that specific business activities also construct and maintain their data marts, and in some cases data warehouses, partially built on top of the corporate data warehouse. This is performed in great measure to ensure agility as was often mentioned by the participants of the commercial segments. This option bears a significant connection to the relevance of BDAC in daily operations and decision-making, which will be further discussed later. How these distinct data marts and data warehouses are often built on top of other data marts and data warehouses, it can be argued that that these decentralized efforts can lead to some lack of architectural coherence.

It was observed that various tools are employed throughout the data lifecycle, largely due to historical reasons (e.g., the merging of different companies) and the autonomy different business sectors possess to make independent investments. Still, although different tools are used, they are often used not only due to historical reasons, but also because past adoption facilitates its usage by different teams. This facilitated adoption supports both data democratization and data sharing cross-activities, as some other interested teams are familiar with these technologies, e.g., SAS and Microstrategy. While providing inputs regarding tools the B2C Director noted:

> *"We have access via SAS, via SAS Guide, which is what's most democratized throughout the organization".*

This comment makes clear how relevant it is the familiarity the company has with a specific tool.

The interviewees from the various business activities agreed on the fundamental necessity of blending business acumen with technological proficiency to produce not only relevant outputs but also to generate relevant insights. This belief is clear in the words of the Director of the B2C Segment when asked upon the relevance of such combination of skills:

> *"There has to be, because otherwise, someone will make correlations of things that are correlated but are neither cause nor consequence".*

The organizational strategies to accomplish this blend, however, vary. Within the context of commercial segments, the B2B segment follows a model where technical skills are centralized within a single team, which then collaborates with specific business teams to ensure the incorporation of business knowledge. In contrast, the B2C segment features a more decentralized distribution of technical skills, housed within multidisciplinary business teams.

In the operations realm, both strategies are employed. In certain operations, due to the backgrounds of the personnel, there are individuals who meld technical know-how

with business understanding. Yet, in other operations, the need to collaborate with other teams prevails. A contribution of the Support Manager is very clear in the dual-strategy followed:

> *"In the world of core customer service, they are essentially people who know the business very well. They have been here for a long time. They are technical, but with a high knowledge of the business. Those kinds of people that the data show a certain conclusion, but they do not stop at the data, they go to the observations, to understand what is really happening in operations. Therefore, they are much more connected to the operation than just technical. In other areas, like in BPO, the teams are more technical, and then there always has to be a more hybrid team where the technicians show the results, but then it has to be the more operational part that looks at them and according to what it receives helps to define the ideal output".*

Although some teams are self-reliant due to a balanced combination of skills, there were consistent references to multidisciplinary collaboration even in such cases. The motivation for these collaborations could be attributed to the need for data originating elsewhere, or because of discoveries that influenced other sectors of the firm both upstream and downstream. Additionally, some of the most significant needs that originated new technological solutions were first identified by one team but required the collaboration of others. This can be exemplified by the B2B commercial support analytical solution, initially developed within the commercial segment, which required data originating in operations. Furthermore, although the primary aim of this solution was to support commercial teams within the segment, the resulting collaboration led to support operations becoming a significant sales channel for B2B products and services, as shared by the Support Manager:

> *"We also sell, we also make sales here, especially in the business market, we are one of the main telephone sales channels for business".*

BDAC provide insights that are mostly shared within the organization, and in some cases with external suppliers. The degree of information sharing varies across different sectors, yet some level of sharing was consistently reported by the interviewees, as was the case of the FF Manager asked if the analytical information was shared:

> *"Primarily with partners, yes".*

And later adding:

> *"They rely on that data"*

Which highlights the importance of sharing analytics. Moreover, it was noted that the organization gravitates towards dashboards displaying the outputs of these capabilities. This trend reflects a growing data-driven mindset within the firm, which is clear in the words of the interviewed B2B responsible:

> *"The best example I have here is that before, no one talked about MicroStrategy, which is where we publish the information. Now, we can be in meetings with management, and the first thing they ask is if it's already on MicroStrategy".*

Additionally, in relation to suppliers, both commercial and field force operations demonstrated a high degree of data sharing derived from the BDAC established within the firm. This information sharing is deemed to be essential. Furthermore, it was referred that the organization pulls for dashboards with outputs of these capabilities, which is seen as required for a growing data-driven mindset within the firm by all interviewees.

The presence of a data-driven culture was clearly evident in the responses of the interviewees. The company was described as being of managers and engineers, which leads to everything being measured, as clearly stated by the Support Manager:

> *"We are in a company that is essentially engineers and managers, and therefore, it is important to show data on everything we do.".*

The B2C Director pointed out a strong need for data collection to facilitate internal benchmarking within the firm, comparisons with international operations, and with competitors. Moreover, everyday operations rely on BDAC for decision-making, with examples ranging from determining which customer to offer a discount for retention purposes, to planning field force capacity to handle expected workload for the upcoming week. In the context of the B2B segment, it was mentioned that previously, decisions were made based on two or three KPI's. As shared by the B2C Manager:

> *"If before we had some situations where decision-making was done with two or three KPIs. Now, those few KPIs that were previously requested are no longer sufficient for decision-making. More is wanted, and this 'more' can only be achieved with advanced analytics".*

Comment that also revealed how the increase demand in calling for the development of solutions based on advanced analytics.

Business Benefits

The interviewees generally believed that BDAC provide the firm with substantial benefits in terms of efficiency and effectiveness, aligned with business objectives. To provide a more detailed explanation of how the firm benefits from these capabilities, we will present the findings through the lens of the benefits management framework employed in this research.

The business objectives identified by this research include the increase of customer satisfaction and retention, improving financial performance, and ensuring regulatory compliance. The firm under study is a market leader in a highly competitive industry characterized by a high level of penetration for its core services. Consequently, there is a substantial focus on maintaining current clients, largely through ensuring their satisfaction. Multiple references to the Net Promoter Score (NPS) were made during the interviews, as a continuously targeted indicator for ensuring improvement, demonstrating a direct connection with the goal of enhancing customer satisfaction. Moreover, the goal

of improved financial performance was generally an underlying topic when discussing objectives. Lastly, given that the telecommunications industry is heavily regulated, achieving regulatory compliance is a prominent business objective, and BDAC are also seen as contributors to reaching this goal as we will further see.

To facilitate the analysis, we will examine the BDAC setups identified in the different studied activities of the firm. Beginning with the B2B commercial segment, the data sources that play the role of IS/IT enablers are diverse as shared by the B2B Manager:

> *"We cross-reference with external information, from other sources, because, as an example, there are external sources of customer characterization information, we also have information from CTT such as postal codes, and so on. Very specific information, but we also have that. Therefore, we actually have many internal sources and many external sources that feed our ecosystem".*

Going into more detail, the data sources include data originated in internal systems – which are divided into Operations Support Systems (OSS), primarily supporting operations and engineering activities, and Business Support Systems (BSS), assisting activities such as marketing, commercial, finance, and billing – and data from external sources, such as data concerning portal addresses and information that supports client categorization. These data sources are integrated into various analytical solutions, as there is an absence of a complete centralized architecture to consolidate the data sources from which users can subsequently be served. These platforms range from an enterprise data warehouse and a data mart that exclusively contains data regarding the mobile business, to a data lake developed by a project that was stopped prior to completion, although still has data updated daily.

In addition to the platforms that facilitate data availability, the B2B segment has created a Gamification Platform, while it is more than a data analytics solution it heavily relies on analytical information derived from big data, a churn prediction model, and dashboards. It is worth noting that in the case of these three components, only a specific subset of dashboards were developed and are maintained by the data analytics team within

the IT function. So, the B2B team is responsible for developing and maintaining several of the dashboards in use as well as some advanced analytics solutions, e.g., churn model.

The identified IS/IT enablers are both results and facilitated by multidisciplinary team collaboration, which can be interdepartmental or within the B2B department. This collaboration led to several business process changes. The B2B Manager explains how P&S portfolio is now managed:

> *"Product teams that are thinking of something often talk to us to understand what the customer base is like, what type of customers have these products, what type of customer doesn't have them compared to the market".*

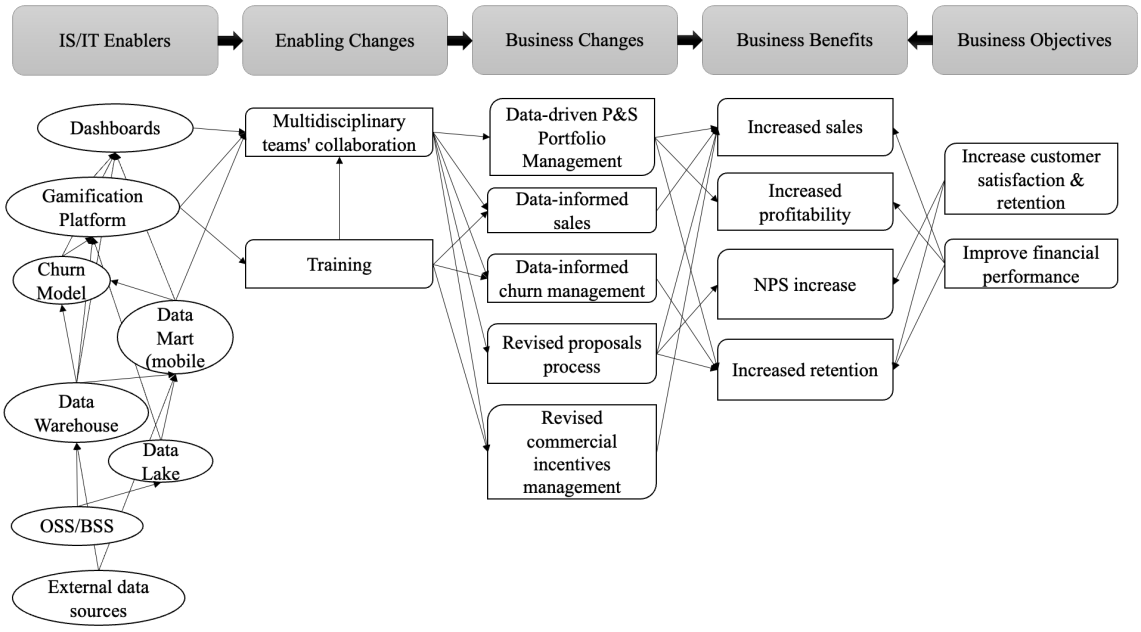
Moreover, Sales activities have evolved, now supported by more extensive client data, a churn prediction model, and a revamped incentives model integrated with a gamification platform. Additionally, a significant process change emerged from the analysis of the churn model. The B2B Manager states:

> *"And the other thing we were able to prove, which was the most interesting part, is that usually when delegating competencies, it would go to the higher levels and normally, there was almost 100% acceptance in an approval process where everything goes to the highest level to be approved. It was realized that this only served to waste time. So, the process died. What people now do is declare in the right place what they are doing. And then the processes are controlling so that people don't abuse the delegation that was given to them. The process was inverted. Time was no longer wasted on approval, but on controlling what each one does".*

The business process changes identified have conferred multiple benefits for the company. Firstly, sales increased due to enhanced P&S portfolio management, more closely aligned with market needs. Additionally, a data-informed commercial team became more effective, partly attributed to a revised incentives approach enabled by the gamification platform. A noteworthy improvement in sales was the new approval flow,

which expedited commercial proposals, increasing sales volume. Furthermore, profitability rose from the new data-driven portfolio management that started to include P&S rentability to support decisions. The changes in the proposal process not only augmented sales effectiveness but also improved NPS and client retention. In this context, both the data-informed churn management and the revised portfolio approach played significant roles. These benefits align with two core business objectives: increasing customer satisfaction and retention, and boosting financial performance, as represented in the benefit dependency network in Figure 8.

Figure 8 –Benefit Dependency Network of B2B Analytical Solutions



Turning our attention to the B2C commercial segment, several data sources are the same, particularly the internal systems, specifically some OSS and BSS, as well as the data lake and data warehouse supplied by the IT function. Notably, this segment also relies on a Data Warehouse independently developed and managed by a team of this specific business activity. This particular Data Warehouse has been highlighted as the main foundation for KPI generation, with results that are made available for visualization through Dashboards. Moreover, leveraging on SAS technology, the segment has constructed what they call a "Customer Data Platform", designed to offer a

comprehensive 360-degree view of their clients. Although this platform has not yet reached the envisioned goal as shared by the B2C Director:

> *"In the way of what could be a customer data platform, it's not quite this yet, but it has the ambition to have a 360 view of the customer".*

Still this platform is already facilitating the creation of sophisticated models, such as the churn model currently in operation. In addition to the internal data sources, external data sets are also utilized. This encompasses not only the information integrated by the IT but also data that facilitates both internal and external benchmarking as shared by the director of this segment:

> *"Whether it's via benchmarks, or comparison, or comparing the evolution of that KPI versus another that has a different evolution. So, we end up always running and comparing ourselves with other operations in the same group and other operations in the same company, and therefore, it's useful in this logic of process and operation".*

The primary enabler identified in this study was the collaboration of multidisciplinary teams. Utilizing analytical insights from both dashboards and the Customer Data Platform, this collaboration effectively merged business knowledge with analytics. The B2C Director emphasized its importance:

> *"Yes, we create and use analytics for up-sell and cross-sell and for managing the business by visualizing the main critical information for customer management for B2C business management. One thing is up-sell and cross-sell for targeting customers, you have information at the level of each customer, but then the aggregation of this, the value of the ARPU, or the customer base, churn, gross adds, users by tariff, or users by technology, by loyalty are all information that appear in these KPIs".*

The process changes included data-driven up-sell and cross-sell campaigns, a refined churn management approach, and data-informed customer relationship management.

Training on analytical tools and a focus on data quality also acted as enablers supporting the collaborative approach. The B2C Director highlighted data quality challenges, humorously noting the implausible age data for some customers:

> *"I have a number of customers who are supposedly over 110 years old; I'm certain they aren't really that old".*

Additionally, there was a managerial focus on simplifying the P&S portfolio, driven by the need for cost-effectiveness and alignment with customer needs. Insights from dashboards and the Customer Data Platform, enriched with customer survey data, informed refinements in P&S portfolio management and broader continuous improvement initiatives.

Data-driven up-sell and cross-sell campaigns, supported by BDAC, were acknowledged for positively impacting new sales by enabling more effective engagement with the existing client base, which was shared by the B2C Director as being essential:

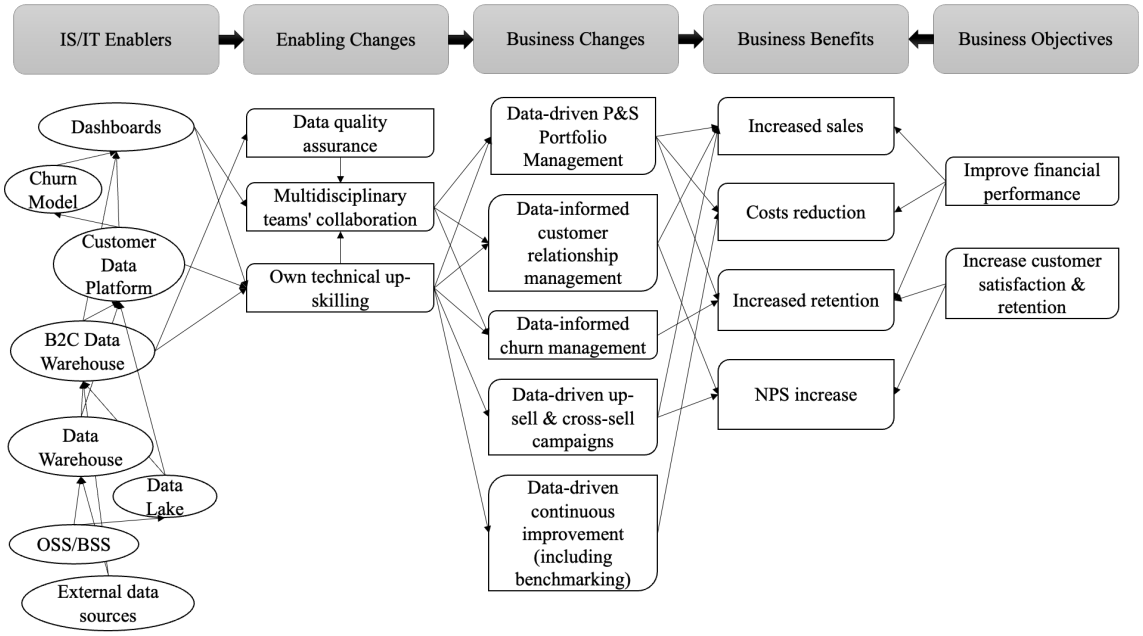
> *"If I didn't produce campaigns, if I didn't identify opportunities to enhance the value of each customer and ended up with customers at a higher risk of churn, in practice, I would be passive, and the customer would either leave or get what they asked for, and customers typically don't call us to request tariff increases".*

This impact is complemented by the continuous refinement of the P&S portfolio leading to a direct response of the business objective of improving financial performance. Moreover, the refinement of the P&S portfolio benefits the firm by allowing cost savings, particularly by phasing out obsolete P&S, thus reducing maintenance costs of older equipment. Cost reductions are also achieved as a result of the data-driven continuous improvement initiatives.

Another key business objective identified to benefit from BDAC is enhancing customer satisfaction and retention. The firm benefits from both increased retention and a higher NPS. Enhanced retention results from better aligning the P&S portfolio with clients' needs and the effectiveness of a data-driven approach to churn management. The

NPS improvement is attributed to more informed customer relationship management and to the targeted data-driven campaigns. These achievements support the business objective of improving customer satisfaction and retention, as represented in the benefit dependency network shown in Figure 9.

Figure 9 –Benefit Dependency Network of B2C Analytical Solutions



In customer support operations, there was a consistent alignment with other firm segments regarding data sources, namely, the OSS and BSS systems, the corporate data warehouse, and the corporate data lake. Given the broader scope of this operation, that goes beyond core telco services, there is a specific system dedicated to managing contact center operations, which is directly owned by this segment and serves as a significant data source in this context. Similar to other examined segments of this firm, there is a self-managed data warehouse that complements what the IT function provides. This could indicate a shortfall in the IT response or, from another perspective, suggest that the unique nature of some operations demands a customized approach with dedicated staff. Moreover, the majority of the analytics derived from the big data present in these data sources are delivered through dashboards, whether they represent operational KPIs or outcomes of more complex analyses.

Mirroring the B2B commercial segment, there is a gamification platform aimed for call center operators, predominantly rooted in big data analytics, that deserved a mention by the Support Manager:

> *"At the moment, we also have a game, which is a platform we created, based again on individual indicators of each assistant, where we play a game in the gamification of the operation itself. It's also on its way to being extended to the rest of the organization, so these are more methodological things in terms of managing call center teams, but anyway, we have been expanding some of our examples in other places, just as we also proudly copy what is working from other areas to our own".*

This comment also implies that there is a collaborative approach within the firm concerning innovative initiatives as is the case.

Customer support operations within this firm are organized in two primary groups: one that serves direct clients of core services and another that offers business process outsourcing services, supporting the customers of their clients. Both groups receive support from the same analytical team, though that team has different degrees of business knowledge depending on the specific operation. Depending on the specific operation, there are different degrees of required collaboration among multidisciplinary teams to ensure business knowledge is integrated in the developed solutions. Leveraging on this collaboration it was referred that a BDAC-driven continuous improvement process approach has significantly influenced operations. Additionally, contact center operator allocation leverages on analytics based on historical data to best match incoming calls with the most suitable operator for specific client.

The existing data-driven approach also has impact on capacity management and supports decisions about which features to include in self-care channels. The BDAC-powered gamification platform was highlighted as a successful initiative with a direct positive effect on contact center operator performance and motivation integrating incentives calculation into the platform. This platform is enabled by the multidisciplinary

collaboration and by the training and divulgation of how both the platform and the introduced incentives work.

The analytical solutions led to changes that benefit the firm in four distinct ways. Firstly, they enable cost reductions, which significantly draw on the efficiency and effectiveness gains achieved by continuous improvement efforts. Well-illustrated by this input from the Support Office Manager:

> *"It's through indicators that I can understand, which is then to see if I need to make any kind of adaptation to the outputs it has".*

Also the optimized support agent allocation based on efficiency criteria, BDAC-informed capacity planning that ensures near-optimal team staffing, prioritized feature inclusions in self-care that deter contact center calls, and revised operators incentives model laying on the gamification platform contribute to costs reduction.

Secondly, there's a notable increase in the NPS. Since client support is the core activity of this segment, it's unsurprising that all the identified changes shared in this research are seen positively influencing NPS, which is also clear in the words of the Support Office Manager:

> *"From there, we extract not only volumes, metrics, but especially factor models. Therefore, when we want to explain, for example, what the main factors are that impact an NPS or satisfaction, we conduct all the data modelling to understand what these factors are and then how we can act on them".*

In addition to the factors contributing to cost reduction, proactive maintenance enabled by the identification of defective equipment batches and revised strategies focusing on customer satisfaction also were mentioned to support increases in the NPS.

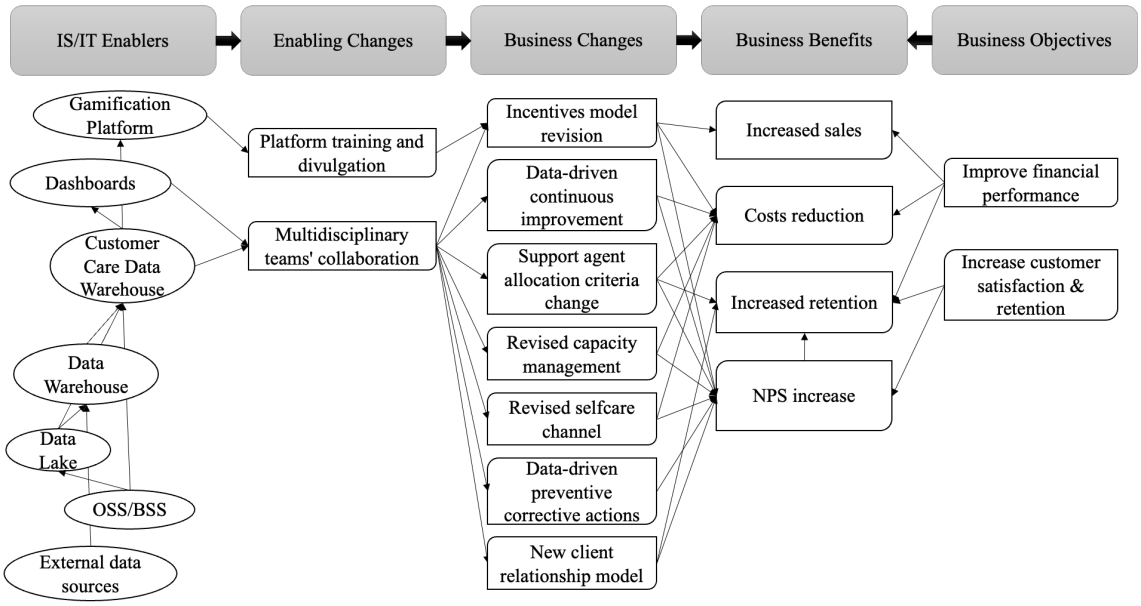
Thirdly, the revised strategies that address customer satisfaction directly benefit customer retention, which also benefits from the NPS improvements. Finally, the Support Manager noted that:

"We are one of the main telephone sales channels in the business sector".

So, increased sales are also a benefit identified in this segment. This benefit was unexpected as this segment does not have the mission to sell, still this occurred as a result of the introduction of the BDAC-enabled gamification platform.

In relation to business objectives, financial performance benefits directly from cost reductions and increased sales, while customer satisfaction and retention are supported by the rise in NPS and improved customer loyalty. Figure 10 represents the benefits dependency network for the solutions that were developed to support customer operations.

Figure 10 –Benefit Dependency Network of Customer Operations Analytical Solutions



Field Force Operations have their BDAC partly supported by the same data sources as other studied segments, including the OSS and BSS systems, a corporate data lake, and a corporate data warehouse. These data sources allow this segment to cross client and operational data, as shared by the FF Manager:

> *"We have access to operational data, so, operational and work data that we execute daily. And we have the correlation of these data with customer data. So, customer interactions with clients. Therefore, we can make the connection between the two areas, the operational area and the customer area".*

In addition to these shared resources, in these operations, following a trend also identified in other segments, maintain their own data warehouse where both internal and external data is integrated. This allows for custom developments tailored to their specific needs, as well as some independency of the IS/IT function.

On top of these foundational components primarily serving as data repositories, there are dashboards for data visualization. Notably, some analytical data and insights, used both internally and externally by suppliers, are accessed directly from the data warehouse, either directly or through data export functionalities. Furthermore, the corporate systems that support these operations also encompass significant big data analytics capabilities, incorporated based on the segment's requests, a topic that we will further develop.

The Field Force Operations segment, that historically manages the largest budget within the firm due in part to the extensive resources required to span the entire national territory, has leveraged BDAC for efficiency gains through multidisciplinary collaboration. There have been process changes in various processes, including data-driven management of scheduling availabilities and improved capacity management. A relevant shift is the enhanced communication with suppliers, increasingly data analytics-based. In this regard, the FF Manager when asked with whom analytics were shared was direct:

> *"Mostly with partners that supply field operation technicians".*

This collaboration integrates insights from both internal and external data sources, like weather forecasting services. These changes provide benefits of cost reductions, NPS increase, and also of increased fulfilment of mandatory service reposition targets, as explained by the FF Manager:

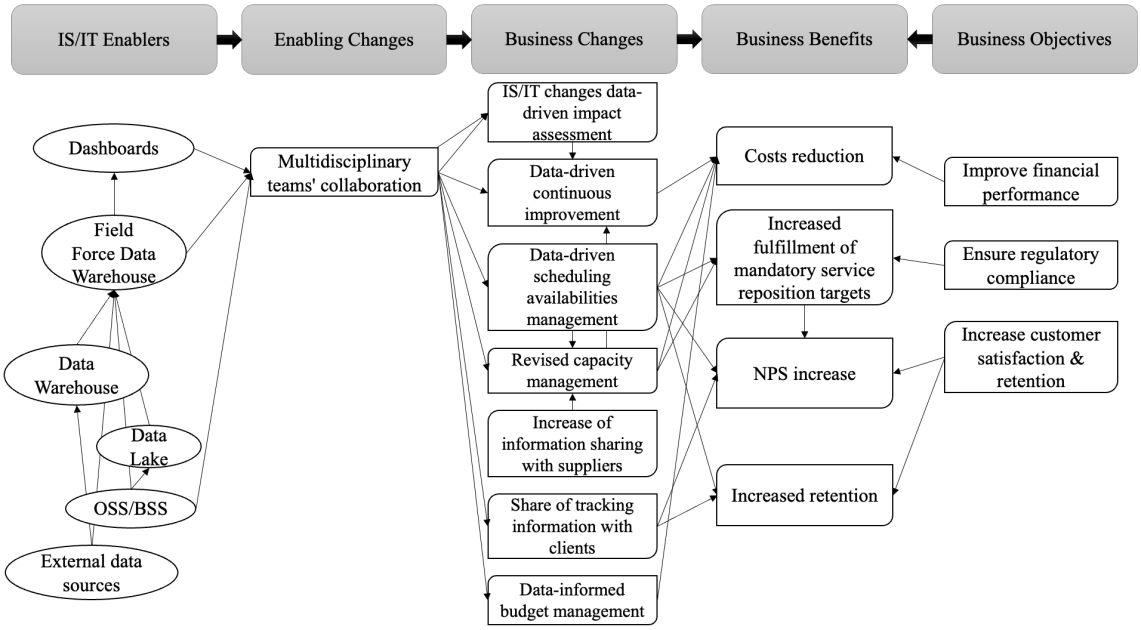
> *"Currently, there is legislation that requires compensation for unavailability, there are specific conditions, it's not just total service unavailability from the second day. Therefore, if we have the possibility to resolve the client's issue by the second day, we won't let the client schedule for the third or fourth day, since we would incur compensation for those days".*

The research also identified a data-driven approach to continuous improvement as a relevant process change. A significant change in this regard is the use of analytics to evaluate the effectiveness of IS/IT changes. The FF Manager elucidated:

> *"When new features are launched in operating systems, we check if the functionalities have the behaviours we expect, right? Whether they perform as anticipated, whether they have the adherence, so when there is not the adherence we aspired to, also through, here it is, data analytics, we can quickly verify that something is wrong, faster than waiting for some comment or formal complaint to reach us".*

Additionally, real-time data sharing with clients, facilitated by BDAC, has led to benefits such as the increase of both NPS and retention. This latter benefit is attributed to more accurate technician scheduling and increased likelihood of clients being home for appointments. The identified benefits align with the company's objectives of improving financial performance, ensuring regulatory compliance, and increasing customer satisfaction and retention, as outlined in Figure 11.

Figure 11 –Benefit dependency network of field force operations analytical solutions



Future Plans

The overall strategy towards BDAC was found to be predominantly decentralized across various segments of the firm, as highlighted by the fact that all interviewees managed teams possessing such capabilities. Consequently, when asked about future plans, approaches varied, though a recurring theme was an ongoing transformation program set to change the majority of current information systems. However, at that point, potential impacts to BDAC derived from that project remained unclear, although some changes were already occurring as mentioned by the BI Manager:

> *"We are already phasing out some systems and trying to unify them to make the migration to the major big data system simpler. But it's very difficult for that to happen, or we would need more time, much more time. We don't know if it's possible, we will try".*

Data governance, this research found to be absent, has been confirmed to be included in the transformation program's roadmap.

Commercial segments anticipate a future where they can concentrate more on value creation activities, as some current activities are transferred upstream, as part of the transformation program's scope. Furthermore, and conversely, within the B2C segment, plans are reinforcing current teams with individuals skilled in advanced analytics, thereby equipping them to exploit the firm's data resources more effectively. On the other hand, B2B expects the transformation program to enable the implementation of vertical solutions as shared by the B2B Manager:

> *"The idea here, to my knowledge I don't know for how long, but is actually to take what is something in the market that is perfectly recognized as good, to put it here inside our system and to use it instead of custom-making things, as we have been doing lately".*

This approach is believed to be easier to maintain than their current custom-made solutions, still it is a significant change compared to was found by this research, i.e., there is a proliferation of diverse custom-made analytical solutions throughout the firm.

Operations were identified to be experimenting with more cutting-edge technologies to gain a deeper understanding of the benefits they could deliver. Specifically, withi the scope of advanced analytics, explorations have been conducted in the usage of text analysis, categorization models, and sentiment analysis. At the time of the interviews, a decision had not yet been reached regarding the advancement of such investments. Nonetheless, some initial results were deemed promising, still too costly as explained by the Support Manager:

> *"We are exploring other ways of using AI, primarily for text analysis, and we have already seen some interesting solutions. However, it's still very early; there are things that will help us. For example, we've seen spectacular solutions from some systems where all calls are recorded. You want to know how many people called about topic A, B, or C, and it automatically cleans all the data and tells you how many there were, who they were, and if you want to listen to the call, it's right there, in those segments. Even sentiment analysis on top of this information, which*

> *is very powerful. It's still a technology that is very expensive to use right now, especially considering the volumes we're talking about, which makes it even more expensive. But I think there's a lot we can do".*

Discussion

The perception that BDAC serve as a source of competitive advantage highlights their potential strategic value. Notably, the transformations enabled by BDAC often go beyond initial plans, aligning with business objectives ultimately, but emerging from opportunities that surface as a result of the analysis of insights generated with other goals. It's vital to emphasize that such outcomes were viewed as feasible only through the combination of technical skills and business acumen, as noted by the B2C Director:

> *"There has to be those combination of skills, because otherwise someone will make correlations between things that are correlated but are not cause and consequence. As no one analytical ever implements at the end of the day, there has to be a buy-in from the owner of the process, and so the analytics, the KPIs, can alert to the need to do things differently".*

The director in this comment also notes how relevant collaboration can be to ensure commitment. Furthermore, this fusion proved to be a significant contributor to instigating changes that result in business benefits. The need and efforts for this blend emerged as a significant theme from the analysis of the collected data, although the studied teams achieved this blend in various ways.

Further exploring how BDAC can be the source of competitive advantages, there was some agreement that BDAC is a source of competitive advantages for the firm, as is clear in the words of the Director of the B2C segment

> *"The use of big data, the advantage, is fundamental for the organization's survival. And yes, using the data allows us to get the most from the organization's main asset, which are its customers and the information they provided. Therefore,*

> *yes, it allows us to gain competitive advantages; if I didn't have information about my customers, I would be blind and clearly at a disadvantage".*

Furthermore, the critical role of data democratization as a facilitator is clearly evidenced by its daily, intentional use, particularly in supporting the gamification platform utilized within B2B commercial channels. Although this platform includes capabilities that go beyond BDAC, the ability to democratize access to data remains central, allowing access to insights regarding clients derived from various sources. Moreover, the B2C segment's continuous efforts to construct a comprehensive 360º customer data platform also relies on the cross-accessibility of dispersed data. Thus, one could argue, from the perspective of the Resource-Based View, that the BDAC facilitated by data democratization contributes to sustainable competitive advantages.

This claim becomes even more compelling when evaluated using the VRIO framework: (1) Value: Democratized access, enabled by BDAC, brings value to the organization by facilitating the exploitation of opportunities, as highlighted in several identified concrete cases; (2) Rarity: The bespoke nature of the data sources and the in-house creation of capabilities lend a degree of exclusivity to the BDAC; (3) Imitability: The BDAC result of an unique blend of technical skills and specific business acumen, so it can be deemed challenging, if not impossible, to replicate or substitute; (4) Organization: Although the BDAC is distributed across the organization, it is exploited effectively within each specific segment. Therefore, while the distribution of BDAC across the firm may initially appear unorganized, each specific segment effectively leverages these capabilities, allowing the achievement of concrete competitive advantages. Aligned with RBV, the application of dynamic capabilities theory suggests that competitive advantage can be attained and sustained through the appropriate utilization of capabilities (Bowman & Ambrosini, 2003). This perspective resonates with the observed democratized utilization of BDAC within the firm under study.

There are several evidence of innovation derived from BDAC. Some are simple processes changes such as the case of change in the proposals' approval identified in the B2B segment following the implementation of a churn model. But there are also

initiatives of larger scale. The emergence of a new customer relationship model from the analysis of support operations data exemplifies an impacting unforeseen innovation derived from BDAC, although this new model is in great measure an initiative that was led by communication segment which is out of the scope of this study, the fact it was originated in operations throw the analysis of insights derived from BDAC is relevant, as explained by the Support Manager:

> *"It was innovative in the sense that it really revolutionized the way we interact with our customers and had a lot to do with how we look at the indicators, the surveys, the satisfaction questionnaires that we use to understand the main factors impacting the NPS. Based on this, we were able to form a new model of customer relationship".*

In line with systems theory, BDAC could be seen as a source of environmental inputs that empowered the firm (or system) to demonstrate enhanced flexibility, innovation, and responsiveness. Moreover, BDAC can be seen as acting as a communication channel with external suppliers, taking a role of that directly influences communication with clients, which can be argued that relates with output as seen under the leans of systems theory. Furthermore, the positive effect on the NPS manifests as a tangible benefits to the firm, resulting in customers who exhibit higher satisfaction and increased likelihood of retention.

Data democratization emerges as a recurrent theme in this case study, given that the activities under study not often operate solely with their own data. Despite constraints presented by the IS/IT function in terms of data provision, there is always a concerted effort to access additional data, which often involves sourcing data from multiple dispersed repositories and implementing mechanisms to ensure data quality. Thus, while data democratization underpins unanticipated innovations, it is also instrumental in realizing planned benefits, serving as a vital catalyst for change. It's worth noting that external data sources are also incorporated under this scope, playing a crucial role in facilitating the intended benefits as they provide inputs from outside the firm expanding the potential of what can be achieved with BDAC.

This research identified that it appears to be a lack of a coherent data strategy, as well as of a data governance function. From the data collected, it is clear that individual segments have crafted their own data strategies which mitigate the effects of this larger strategic void. Yet, the absence of a clearly articulated data strategy could potentially pose as a threat. This is illustrated by the introduction of a new customer support system in which analytics were not initially incorporated, as shared by the Support Manager:

> *"It hasn't started properly yet, there's less than 2 months left for the first operational phase to begin and we don't have associated country KPIs, we don't have anything, and we won't have it in that period. Even though the first phase has a limited scope of use because it will be with a very restricted number of people".*

At the time the data was collected, this omission was causing some level of concern. Such concerns, however, is moderated by the fact that, in a decentralized manner, individual segments historically end up being able to gain access to the data they require to fuel their BDAC. Furthermore, approaches to data democratization are inconsistent due to the absence of a company-wide strategy, and decisions in this regard are made in a decentralized fashion. Therefore, these adaptations can be argued to be a reflection of the adaptability characteristic of dynamic capabilities.

Conclusions

The primary research question of this study is: "How do firms benefit from Big Data Analytical Capabilities?" Keeping this focus in mind, the analysed firm provided a substantial foundation for a comprehensive analysis. The main benefits observed largely manifested as instances of efficiency and effectiveness. In terms of efficiency, gains in sales could for instance be attributed to the BDAC-powered capacity to better understand and approach clients with commercial offers. Additionally, regarding effectiveness, the offerings made available to clients were managed based on their actual efficacy in current business operations.

The discoveries extend beyond the traditional efficiency and effectiveness, as well as enhanced decision-making, which are well-documented benefits of BDAC. The benefits with a stronger focus on the clients emerged as highly relevant in enhancing the NPS, particularly where BDAC was perceived as an enabler for defining a novel client relationship model. The impact of a model of this nature surpasses the well-known benefit of enabling improved client performance, especially when designed with the objective of cultivating an empathetic relationship with clients. Thus, the collected data suggested that BDAC can support cultural shifts as is the case of the one derived from the new relationship model, although such assessment would require data beyond the scope of this research. Nevertheless, there were recurrent mentions of a significant impact on the decision-making process, which may or may not reflect a cultural shift but holds considerable relevance in how the firm makes decisions. Yet the influence of BDAC is believed to have the potential to extend beyond this, leading to a reconfiguration of how the firm interacts with the market.

The ramifications of democratized data access, as seen within the segments of the company studied, suggest a latent potential for innovation arising from the interplay between BDAC and data democratization. This leads to meaningful benefits for the firm, some of which may not have been initially foreseen. The change in the proposal approval process stands as a compelling example of an unexpected process change stimulated by democratized data access, given there was no active intention to revise that specific process. Therefore, this combination of BDAC and data democratization, coupled with their subsequent effects on innovation, emerges as a key discovery of this case study. Although for the referred effect to happen, it is crucial to emphasise the necessity for a combination of technical and business skills, which are instrumental in facilitating such outcomes.

4.2 Case Study 2 – Logistics

Introduction

This second case study focusses a firm that is primarily characterized as a logistics operator. Despite its main classification, there is an ongoing effort to diversify its offerings, largely by leveraging on its extensive physical presence throughout the country, which encompasses logistics centres and retail shops. These diversification initiatives have led to the introduction of offerings such as retailing products in physical stores, like books, and introducing financial services including savings products. Fundamentally, the company specializes in deliveries, a sector that has become increasingly competitive, even more with the effect of the COVID-19 pandemic. It is also due of note that this firm holds a historically significant position in the Portuguese logistics market.

During the research, it became evident that there is a pronounced intent to enhance financial performance in response to the shifts impacting the company's core business. One representative change is the decline in package weight, which poses challenges for the firm because its pricing model is significantly based on weight. This has led the company to pursue significant operational enhancements. Concurrently, to the diversification strategies that are underway to cultivate new profitable business lines, ultimately targeting enhanced financial outcomes. Additionally, issues surrounding customer satisfaction and retention, along with regulatory compliance, were also identified as relevant business objectives. Particularly, given the company's operation within a heavily regulated environment, the latter is particularly relevant.

To address the identified business objectives, as will be elaborated upon later, BDAC was deemed increasingly relevant in delivering benefits aiming towards meeting those objectives. The organization's recent strategic decision to integrate their Data Office team within their corporate services – intended to serve the broader organization – reflects a paradigm shift in how they envision these capabilities serving the firm's interests. At a macro level, the company is structured into three main high-level divisions: corporate services, operations, and commercial segments. The collaboration agreement with this

firm allowed the participation of a representative of each of these divisions as well as from the Data Office. So, the participants from this firm are:

- The Executive Director responsible for Operations, subsequently referred to as the Operations Director.
- The Executive Director responsible for commercial segments (B2B and B2C), subsequently referred to as the Commercial Director.
- The Executive Director who is responsible for the Planning and Control function and also the Data Office, subsequently referred to as the Corporate Director.
- The Data Office Manager, who heads the technical analytical teams that work across the organization.

The input from these participants allowed a multidimensional view of the firm's adoption and application of BDAC, specifically allowing a focus on operations and commercial activities.

Big Data Analytics Capabilities

The subject of this case study, a logistics firm, demonstrated the presence of big data analytics capabilities throughout the activities researched. However, it is worth noting that the application of these capabilities was not evenly distributed. A significant portion of the supporting big data is produced via the company's operations, especially linked to lifecycle events during the distribution cycle of their deliverables, as noted by the Operations Director:

> *"Just to give you an idea, we have two types of objects being delivered. Some have traceability, and others have traceability and many events. Each object with traceability has an average of 8 to 10 events throughout the distribution cycle. We're talking about an average of eight million objects per month, and an average of 10 events per object. This means we're talking about an average of eighty million events in the system on a monthly basis. It's not a huge amount of data, but it is significant".*

In addition to operations data, client information was identified as a substantial source of big data. This pool of information is further enriched by externally procured data, which aids in conferring additional structure to the data generated internally. The integration of external data aims both the enrichment of the existing dataset and the increase of precision of analytics outcomes.

The operational structure of the logistics firm in question is characterized by a reliance on both internal capabilities and external suppliers involved in different steps of the delivery process. This setup calls for the integration of data from these external entities, a process facilitated by application programming interfaces (API), which are also used to integrate with some larger B2B clients. Simultaneously, the firm faces internal integration requirements due to the employment of scanning equipment used to read package codes. These external and internal data integration demands pose significant technological challenges. Specifically, these impediments obstruct the provision of real-time data as shared by the Operations Director:

"I would like it to be in real time, but we can't get everything in real time".

This feature was highlighted as potentially advantageous for further improvement of operational efficiency. Thus, these technological constraints stress out the critical role of effective data integration in leveraging big data analytics capabilities, although the capabilities in place at the time this study took place were deemed as a source of benefits as we will further explore.

Operational, client, and financial data, which are recorded or integrated into the company's systems, constitute the three primary categories of data identified as being used. The richness of these data sources is further amplified by the incorporation of external data. From an architectural standpoint, the firm under study was at the time data was collected in the process of migrating to a cloud-based environment. The migration strategy is twofold: for some sources and usage scenarios, data is consolidated in a data warehouse, whereas in others, a data lake is used as noted by the Data Office Manager:

> *"Information with more detail stays in the lakehouse, and aggregations and such stay in the data warehouse".*

From a data visualization point-of-view the firm relies mostly on Power BI dashboards. The firm's choice of the target data architecture underscores the ongoing transformation of its big data analytics capabilities and the strategic alignment with evolving technology trends which is deemed as essential for supporting the company strategic transformation objectives.

The subjects interviewed agreed on the necessity of possessing both technical and business acumen to facilitate effective big data analytics. While approaches for ensuring this blend of competencies vary across the firm, the presence of a diverse skill set remains a consistent factor. The Data Office team, tasked with generating a substantial proportion of the analytics currently in use within the firm, relies heavily on the support of the Planning and Control team. This adjunct team within the current organization plays a critical role in ensuring the Data Office's possession of pertinent business knowledge, a prerequisite for producing relevant analytical outputs.

Laying on top of the work executed by the Data Office, both the commercial and operational functions maintain some degree of autonomy in analytics production. In both instances, they regard a high level of independence as essential for guaranteeing robust analytical capabilities, which is clear in the words of the Commercial Director:

> *"We want to be autonomous in producing this knowledge. We don't want to be tied down in an old-school manner, making a request to the IT team to run 4 or 5 queries for us and then working in Excel. None of that".*

This autonomy is perceived as an integral component of their strategy for maximizing the benefits of big data analytics, and the interviewees of both these areas shared their interest in seeing these capabilities grow within their business activities.

The BDAC currently in place are being used in diverse ways across the sectors under study. The most prevalent application of these capabilities is evident in the use of

dashboards that provide KPIs relevant to various activities conducted within the firm. These dashboards are seen as vital for ensuring that the firm's activities are conducted both effectively and efficiently. Production of these dashboards is observed in the Data Office but is also develop by staff members within both the commercial and operational activities. It is important to highlight that the sourcing of data for these capabilities is predominantly managed by the Data Office team. There is a concerted effort towards centralization of these data sources, particularly given that a data source deemed relevant for a specific segment today could potentially be pertinent to another in the future, as explained by the Data Office Manager:

> *"We always try to bring value to the organization by thinking about what will bring us value moving forward. Why? Are we just going to do this small project and respond to this report A, or are we going to bring in more information and add more value to the organization? That's the way we work".*

This strategy could be argued as facilitating data democratization from a data consumption perspective, and even as having an enhancing effect on the firm's overall big data analytics capabilities.

As will be further discussed in the subsequent section, the firm' activities studied have developed specific capabilities within the scope of big data analytics that support the fulfilment of business objectives through the achievement of business benefits. Beyond the employment of dashboards that aid decision-makers in ensuring effectiveness and efficiency, the Operations sector also takes advantage of more advanced capabilities. A specific example is the solution that facilitates the planning and real-time tracking of delivery routes, which has been proven to enhance operational efficiency by reducing time spent. Regarding this solution the Operations Director noted the relevance of ensuring monitoring:

> *"What happens is that if we have the data for optimization and use it live for monitoring, you might be designing something wonderful that saves 30% of time.*

> *But if people aren't following it, and you can't monitor, you'll never achieve the savings and gains that were planned in the design".*

The Commercial Director acknowledges a persisting need for further investment in BDAC. However, at the time he was interviewed, beyond the usage of KPI dashboards, there were other significant applications of these capabilities. Noteworthy examples include churn models, up-sell and cross-sell models, and the generation of insights that inform product management in the development of new offerings. This reflects the diverse ways in which BDAC are harnessed to drive business goals within the organization.

An increased focus on cultivating a data-driven mindset within the organization was observed during the course of this study. The introduction of Objectives and Key Results (OKR's) emerges as dominant theme, sustaining the argument that it was a major catalyst, increasing the need to equip various segments of the firm with robust analytical capabilities. However, the allocation of these capabilities seems uneven. As the Commercial Director observes:

> *"I believe that we are a data-driven organization in some clusters within the business units we manage, but not yet in all of them".*

Still, the firm's strategic decision to put together the Data Office and the Planning and Control team appears to have had a ripple effect, boosting the development of BDAC within the organization. Further evidence of this emphasis on BDAC comes from the Directors of both Operations and Commercial activities. Both came from companies they perceive as being more advanced concerning these capabilities. This prior exposure could explain their continued efforts to ensure greater adoption and utilization of BDAC within their respective business activities, as they are well acquainted with the benefits that these capabilities can offer.

The studied firm is consciously progressing towards becoming a more data-driven entity, extending its BDAC to fulfil this ambition. However, certain challenges have

emerged and are capturing attention. These challenges are broadly classified into two categories. The first set of challenges is technical in nature, predominantly concerning the ability to capture and make available large volumes of data as mentioned by the Operations Director:

> *"For example, the computational capacity and the structure or architecture of how the databases and systems are organized often make it difficult to have real-time data, or data with a high refresh frequency".*

In certain instances, these data originate from scattered legacy systems, which adds complexity and length to the process. An additional technical difficulty lies in correctly associating client-related records, attributed to an incomplete understanding of the relationships of the records.

The second category of challenges is cultural, exemplified by the perspective of the Operations Director. He asserts that:

> *"It is imperative for the top management to know what can be done, not necessarily how to do it, but at least to request it and to make decisions".*

This encapsulates both the need for a shift in mindset at the top leadership level, and also the perception that training focussed on BDAC can support that mindset change. Moreover, an observed lack of coherence in the way analytics are employed was noted, particularly by the Commercial Director when he states:

> *"The way we disseminate information afterwards, is sometimes too confusing", denoting a perceived lack of organization on how analytics are shared within the firm.*

Business Benefits

The research participants consistently indicated that BDAC constitute a source of business benefits. From a broad perspective, these advantages can be categorized into

both effectiveness and efficiency benefits. To dig deeper into how the studied firm capitalizes on BDAC, we will elucidate the specific benefits identified through the lens of the benefits management framework adopted in this study. Furthermore, the business objectives identified during this research encompass the increase of customer satisfaction and retention, ensuring regulatory compliance, and improving financial performance. Notably, the interview participants emphasized more often the improvement of financial performance. This focus can be partially attributed to the pressures originated in changes in their traditional business. To achieve this objective, they target several BDAC-supported business benefits, which contribute to both cost reduction and sales growth.

This company was found to increasingly leverage technology, particularly within the scope of BDAC, to manage their operations. The primary source of their data are the OSS, which subsequently feeds a data warehouse maintained by the data office team. Some B2B clients have directly integrated their systems with the company's systems, thereby expanding the amount of data available for analytical purposes as shared by the Operations Director:

> *"There's a portion that comes from the client, from interactions with the client, usually interactions via API. And the rest is within the corporate tools we have, which are the systems managing this entire productive process*".

Additionally, the company uses a system dedicated to route optimization. While this system primarily serves as an operations support tool, its significance from a BDAC perspective cannot be overlooked. Moreover, a specific solution for revenue assurance, which heavily depends on big data analytics, was identified. Furthermore, the predominant means of accessing analytical insights was through dashboards. Some of these were developed by an internal operations team, while others were the result of the work of the data office team, a point we will further develop.

The Operations Director was a relatively recent appointment, similar to the case of the Commercial Director and of the Corporate Director. Focusing on operations it was evident significant steps forward towards a more data-driven culture, with the current

leadership profile serving as a catalyst for these improvements. The increasing inclination towards data-driven decision-making is encapsulated in the words of the Operations Director:

> *"We use the indicators to guide actions and not the other way around".*

Also, the introduction of OKR's within the organization further drove the adoption of a more data-centric management style. Coupled with data quality initiatives that were found to indispensable, this transformation in management induced several impacts on business processes. The firm experienced enhancements in its continuous improvement initiatives, specifically targeting cost savings and quality improvements as noted by the Operations Director:

> *"Big data is not only used for designing but also for monitoring, and naturally, everything ends up having the benefit of cost savings and quality improvement".*

Other processes were also changed, the billing process was refined to occur in a more favourable timing. A more data-informed approach to planning unveiled opportunities to reduce the workweek from five to four days in certain regions and increased the ability to anticipate a more precise operational capacity required to meet actual needs more accurately. Near real-time data availability increased the decision-making capacity of regional and operational managers that oversee delivery activities, and promptly identify and implement corrective measures, and address related upstream and downstream tasks. Of significant note was the heightened capability to engage with regulators, offering data-backed responses to audits and explained by the Operations Director:

> *"From a regulatory standpoint, the regulator has its own means of evaluation, with a series of panels throughout the country, and they know about the letters and packages sent and which ones are received. And for us, the only way to confront this performance evaluation against the regulatory rules is to have our own analytics to dismantle the argument, to add value from the standpoint of these*

> *conversations, and of penalty, well, penalty, evaluation, however you want to call it".*

Worth mentioning is the presence of a specialized team within operations. Possessing technical competencies similar to the data office team, this team exclusively serves the operations segment, enabling some of the process changes mentioned.

The process changes empowered by BDAC have supported the studied firm in achieving several business benefits. Reduction in working days, coupled with data-driven continuous improvement initiatives, have led to a decrease in operational running costs. Concerning the 4-hour working model it is worth noting that it was done with the concern of keeping the agreed SLAs as noted by the Operations Director:

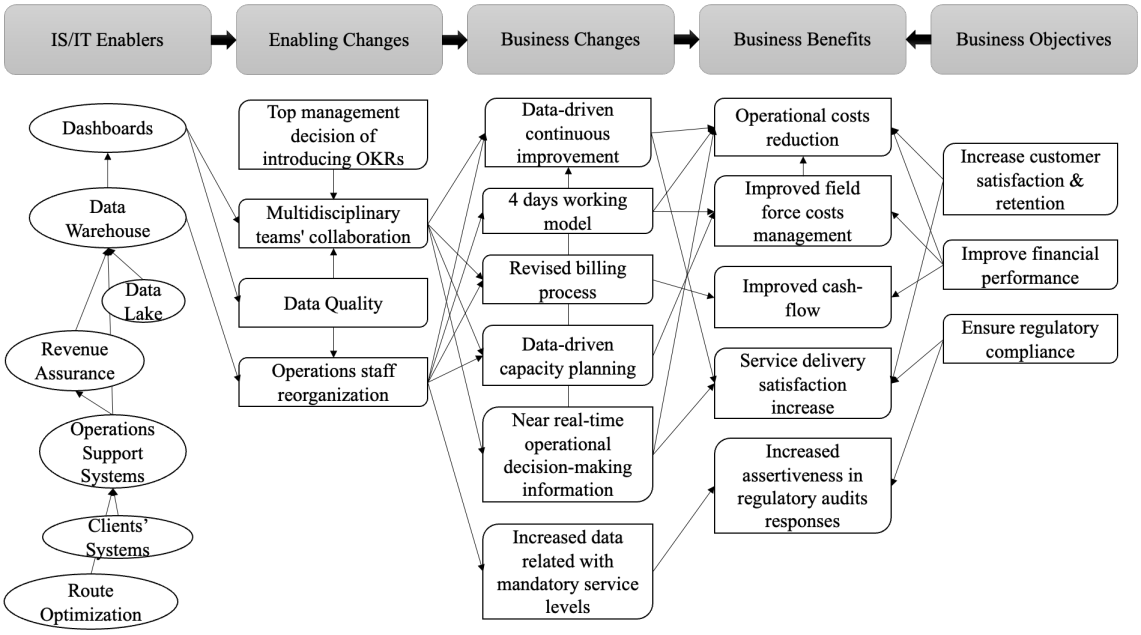
> *"This is not just a change in the distribution model, it's also a change in work schedules, with the ultimate rule of not reducing quality and continuing to guarantee the SLAs defined by the customers".*

Also, the near real-time accessibility of analytical data concerning operational teams, combined with robust forecasting capabilities, has supported cost reductions initiatives specifically related with the field force. This is especially significant for a firm that outsources a portion of its required capacity.

Due to the improvements brought by BDAC, the firm was able to streamline its billing processes, enhancing cash flow. These advantages directly align with the business goal of improving financial performance. Furthermore, the heightened availability of analytical data for regional operational managers amplifies their ability to oversee and influence daily operations, leading to an improved customer satisfaction in the services delivered. This progress supports the company's ambition to increase customer satisfaction and retention levels. Lastly, the improvements made in data quality and availability have ensured more precise information targeted to assist the firm during audits performed by the regulator. The capacity to provide data-backed responses to regulatory entity not only strengthens the firm's credibility but also aligns with the

business goal of ensuring regulatory compliance. Figure 12 represents the benefits dependency network for the solutions that were found to support the operations segment.

Figure 12 –Benefit Dependency Network of Operations Analytical Solutions



Analysing the information gathered related to the commercial segments, the primary data sources are BSS, with a relevant emphasis on billing and CRM systems. The use of external data sources was also highlighted, predominantly to support the enrichment of client data that has been collected by internal systems as shared and exemplified by the Commercial Director:

> *"We purchase external information that enriches what we already have, not just in terms of information scope, but also to give some structure to something that is still unstructured on our side. So, for example, in B2B, for business clients, it's important to have an external source with the identification of all the companies that exist in Portugal to understand the tax identification numbers".*

Data originated from operations support systems was identified as a being a relevant source for analytical analysis that serve this segment. Data from the referred data sources

is consolidated into a data lake developed and maintained by the data office team. From this data lake, information is loaded into a data warehouse under the same team's management, and also into a data mart. This data mart is specifically designed and maintained by a team that only addresses the needs of the commercial segments. It is worth noting that the data mart is currently organized by channel, although it is considered that an organization by client would better serve the segment' needs. Finally, regarding data visualization and support for analytics consumption, data consumers are served predominantly through dashboards and files that are extracted from both the data lake and the data warehouse.

The collaboration between multidisciplinary teams to facilitate the use of IS/IT systems emerged as a dominant theme from the collected data. The top management decision of introducing OKRs also had and enabling impact on BDAC visible in the commercial segments. Digging deeper, the synergy of business acumen and technical expertise led to several key changes in business processes. Client management was enhanced through the use of a churn model, leading to better knowledge about clients at risk of being lost. Campaign designs have adopted a more data-driven approach, especially with regards to up-sell and cross-sell initiatives. These enhancements were in part attributed to a richer understanding of client behaviour, which also informed the product management team in refining current offerings and developing new products. An example shared by the Commercial Director is very illustrative of the impact of the analytical behaviour analysis in product management:

> *"We decided to proceed with the deployment of a network of lockers largely due to the identification of convenience needs in delivering shipments to individual customers. Therefore, this was one of the things that was flagged in terms of behaviour, which was something that the customer themselves wanted".*

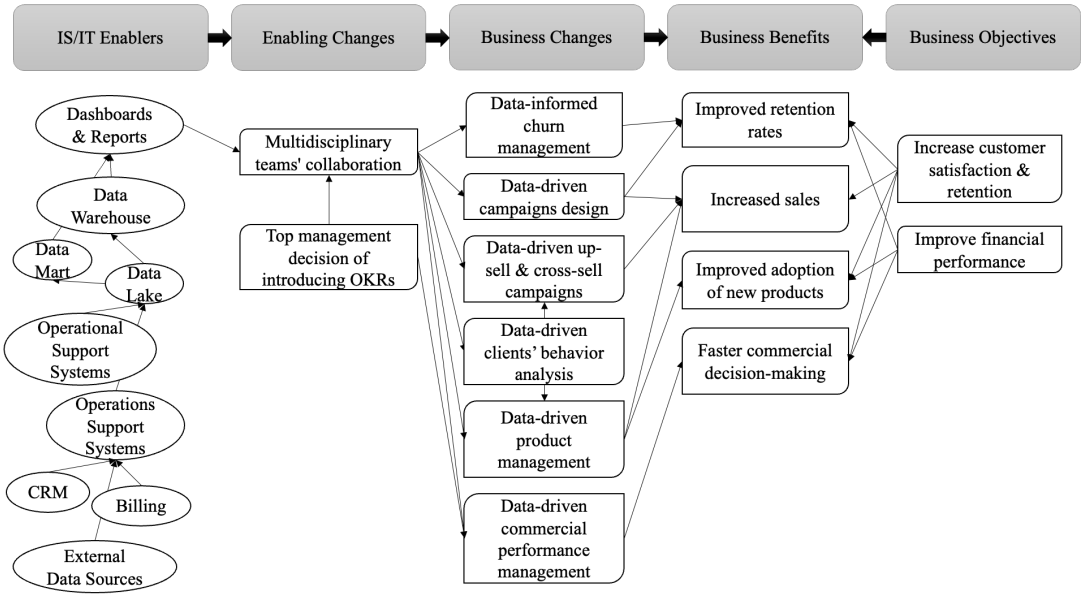
The introduction of OKR's transformed how commercial performance was evaluated. There appears to be a more direct correlation with the firm's objectives. This is perceivable in the words of the Commercial Director when discussing the OKR implementation:

> *"From the perspective that we are starting here with OKRs, all the actions we develop at the segment level align with what we intend to be their overall contribution to the company's objectives".*

The implementation of business process changes supported by BDAC has allowed the studied firm to achieve significant benefits. Client management strategies, informed by the insights of the churn model, coupled with campaigns designed with access to enriched client information, have enabled the firm to achieve better retention rates. Further, with a deepened understanding of client behaviour, campaigns – particularly those focusing on up-selling and cross-selling – became more effective, leading to sales increase. Furthermore, the evolution in product development has not only improved sales of current offerings but has also paved the way for the introduction of new products that are up-front expected to directly meet market demands. These advancements support the firm's pursuit of improved financial performance, especially as segment management becomes increasingly aligned with the segment's financial performance expectations, an alignment accentuated by the influence of OKR's. While the adoption of OKRs has indeed intensified the segment's drive and perhaps increased the pressure, it has allowed an increase of the amount of information available for informed decision-making, proving benefits for the business.

Ultimately, the improved retention rates, the increase of decision-making data, and the introduction of products developed to meet client needs serve the firm's business objective of optimizing customer satisfaction and retention. Figure 13 represents the benefits dependency network for the solutions that were found to support the commercial segments.

Figure 13 –Benefit Dependency Network of Commercial Segments Analytical Solutions



Future Plans

Participants highlighted future plans concerning BDAC, shedding light on how these capabilities are perceived within the company. Within the commercial segment, there's an inclination towards adopting more advanced tools that allow better client indicators and information. Notably, the intention to use SAS was mentioned, as there is an anticipation that such a tool would enhance the existing analytical capabilities, being believed that the adoption of that technology would be a step forward compared with current usage of PowerBI. Additionally, the Commercial Director emphasized the need for enhancing the technical skills of existing employees, viewing this as critical for advancing to more sophisticated capabilities. Specifically, a preference for solutions based on Python was indicated. However, it was underscored that:

> *"I would really like to get there for all intents and purposes, but I'm uncertain if the progress will be as swift as desired, given the substantial effort required to cultivate internal skills".*

Complementary, also new hiring efforts were said to be in plan, being referred an operating model that promotes a balance between technical and business profiles.

In the operations segment, there's a pronounced preference for real-time data over monthly or weekly reports. However, such a transition is perceived as challenging due to technological constraints. In this context, transitioning to cloud computing is deemed essential since it represents a significant technological upgrade to the current infrastructure. This is especially relevant given the stated inclination towards adopting artificial intelligence solutions, which existing infrastructure is not considered capable of properly supporting. The Operations Director underscores the importance of enhanced data availability, especially when managing operations across 240 logistics centers nationwide. In the absence of real-time data, the only option to ensure everything is running smoothly at a specific point in time is to:

> *"Pick up the phone and call those 240 individuals".*

It is noteworthy that recent changes, which enable operations to access daily updated information, do provide a mitigating effect, though it is not quite equivalent to real-time updates.

From the perspective of the Data Office Manager, beyond the already mentioned strategic shift to a cloud environment, there's an aspiration to transition to a model where data is provided to the organization as a service:

> *"Maintaining the Microsoft architecture, and making data more available as a service to the organization. We are seeing a trend of loading more information into these lakes, this analytical model, and then making it available for applications or for people to consult this information".*

In this operating framework, the Data Office team would assume the responsibility of data collection and its integration into analytical models. These models would subsequently be made available to the broader organization. This strategic shift implies a move towards promoting self-service analytics. Anchored in a centralized approach, it can be argued that the goal is to facilitate a more distributed use of data, fortifying BDAC's role throughout the enterprise.

Discussion

The firm underwent a significant organizational shift by moving the Data Office team together with the planning and control team, leaving the IS/IT function where were previously integrated. This realignment seems to favour the implementation of OKR's reporting, introduced in the same year as the data collection. This tactical organizational decision appears to have had a positive effect on this technical team by granting them more direct access to business teams. As expressed by the Data Office Manager:

> *"This involvement is critical, essential".*

Although this team has been acknowledged for its substantial support to both the operations and commercial segments, both these segments refereed they require additional specialized resources to evolve their BDAC. This demand highlights the activities' ambition to capacitate themselves with more sophisticated analytical methods, which can be argued to be an indicator an intent to develop their own segment specific data strategies.

The integration of OKR's appears to have acted as a catalyst for BDAC. However, it can argue that it has directed the Data Office's priorities, steering the roadmap to initially introduce features that answer OKR's needs set by senior management, while relegating to the bottom of the list features more aligned with segment-specific needs. Such prioritization may contribute to the already noted segments' identified requirement for an expanded staff capacity to meet their needs.

The data collected indicates a significant centralization of key activities within the Data Office. Nevertheless, both the operations and commercial segments are keen to enhance their BDAC capabilities, an intention confirmed by the Data Office Manager:

> *"Several departments are seeking data analysts to reduce their reliance on the Data Office and to construct solutions that allow for swifter information retrieval within their own domains".*

In this environment, which appears to be promoting a more decentralized approach to BDAC, the establishment of a data governance function might be expected. However, while most participants perceive the Data Office team as responsible for data governance, and even believe it is already in place, its Data Office Manager clarifies that they have only initiated a foundational, theoretical framework. Still, the importance of data governance is recognized and prioritized for future development, given that the current lack of a comprehensive governance structure could jeopardize investments related to BDAC.

From the case analysis it can be argued that the strategy includes the Data Office taking the lead in data collection and modelling, ensuring that the organization's data is available for further use. They also design dashboards that grant the various segments facilitated access to relevant insights, aiding decision-making. However, a notable trend emerged: while all segments benefit from the services provided by the Data Office, many are proactively investing in the creation of specialized teams to develop their own data solutions. Moreover, these individual segments display an inclination towards adopting sophisticated analytical technologies. In contrast, the Data Office predominantly focus on improving the data engineering layers and preparing data for those who might gain of having access to it. It can be argued that the Data Office's efforts to ensure data available and pre-modelled data demonstrate a commitment to data democratization. Such an approach empowers various segments to access data without the need for highly specialized skills. Additionally, when segments decide to invest in more specialized personnel, they are access to platforms that facilitate the creation of data solutions, being them more advanced or just more focussed on their specific needs. Still, in either case they exhibited an intent to own and apply specialized skills, which challenges the data democratization assumption.

The data collected consistently suggests a belief that BDAC can serve as a source of competitive advantage. Although some participants are not assertive about the foundation of this belief, the Corporate Director presents a developed rational that links BDAC with competitive advantage, especially in the context of the firm’s expansion plans. He

believes that the data collected from the Portuguese market – where the company has maintained a significant presence over the years – combined with data from a subsidiary in Spain, can provide a foundation for future competitive advantages grounded in BDAC.

From the perspective of the Resource-Based View and, more specifically, the VRIO framework, the capabilities evident at the time of the interviews appear to align with this theoretical model. In terms of Value, data related to clients, in both countries, and logistics are valuable assets. The Rarity of the data the firm holds is evident, especially given its unique nature. Imitability also aligns with the firm's position since its data is proprietary, which is particularly relevant in Portugal where the company has a dominant market position. The Organizational criteria seemed less solid at the time the interviews were conducted. However, as the Corporate Director noted:

> *"For instance, we are now migrating to a model that had been built in Spain. In practice, the way we relate to the customer still varies between the two markets".*

This suggests ongoing investments aiming towards assuring an organization capable of leveraging BDAC for gaining benefits. This intent is further stressed out by:

> *"It is precisely the integration of data and the creation of unique teams and unique information models that will give us competitive differentiation capabilities that our competitors do not have, and which will naturally help us achieve the market share objectives we set for the Iberian Peninsula for 2025".*

BDAC have been observed to significantly influence various business processes, resulting in a wide range of efficiency and effectiveness outcomes. However, one transformation directly attributed to BDAC stood out due to its unanticipated nature: the transition to a 4-day working week in specific regions. This adjustment was driven by the realization of a surplus in structural capacity, as mentioned by the Operations Director:

> *"Right now, we are implementing the new distribution model based on 4 working days instead of 5 because it was identified that we had an excess of structural capacity on several days of the week. Therefore, we changed the distribution*

> *model for the more remote, rural areas. In which the work that was previously done in 5 days, we now have concentrated in 4".*

Expanding on this shift, the Operations Director emphasized the indispensable role of BDAC:

> *"It's a challenge that without data, we could never tackle. Without having a data analysis that tells us we can balance the working hours per week in a regular way to ensure that we have more work in 4 days and that 1 day is much weaker and can be used for days off. Without strong data analytics behind, and the ability to dig deep, we wouldn't have been able to undertake this change".*

Thus, within a labour-intensive segment of the firm, as in the case of Operations, BDAC facilitated a structural change, predominantly attributed to the enhanced data-centric approach adopted by the management. This example illustrates the transformative potential of a data-driven culture into leading to benefits originated in BDAC.

In line with more unanticipated innovations, the Commercial Director highlighted the lockers solution offered by the firm. This initiative emerged from an enhanced understanding of clients through the continuous development of BDAC. This example embodies a broader benefit observed in the commercial segments: the confident introduction of new P&S, supported by a substantial pre-existing insight into client needs. Another example was the creation of an online marketplace that was created due to the perception that, during the pandemics, the firm's clients required a service of this nature the process that led to the creation of this channel was explained by the Commercial Director:

> *"During the pandemic, there was a great need for us to have an online presence. We were contacted by many clients who were our delivery clients and who suddenly wanted to delve deeper into the context of e-commerce, so there was this analysis. There was this evaluation that identified the need for us to be not only the delivery partner but also a comprehensive e-commerce powerhouse, providing*

> *a complete tool for all the necessary actions for selling, transacting, and delivering online".*

From another perspective, it can be argued that BDAC empowers the firm to receive relevant data inputs from its external environment, aligning with open systems theory. Moreover, particularly within a commercial context, BDAC appears to be instrumental in facilitating deeper insights into client behaviour, as is clear in the words of the Commercial Segments Director when referring both the lockers and the ecommerce portal:

> *"All of this was driven by a much deeper customer knowledge than what we had in the past".*

For a company that strongly pursues diversification of its offerings, these insights can be of great importance. The challenge of keeping decision-makers adequately informed is accentuated when the firm's focus is expansive and undergoes frequent modifications. Thus, BDAC was perceived as pivotal in informing decision-makers and facilitating the decision-making process.

Conclusions

At the time the data was collected, this logistics firm was actively working on improving their BDAC. Notably, the introduction of OKRs appeared to serve as a catalyst, as they normalized the necessity of having data to validate the achievement of objectives. Taking into account the background of the interviewees, it's significant to note that all three Directors interviewed were relatively recent hires that originated from companies that they perceived as being more advanced in the adoption of big data analytics technology. This suggests that management changes can play a pivotal role in leading the organization towards better harnessing the potential of BDAC. The specific benefits derived from BDAC vary depending on the business segment in focus. However, when viewed from a broader perspective, the primary benefits lie in enhanced efficiency and effectiveness, mostly due to improved decision-making capabilities.

Delving into specifics, within the commercial segments, BDAC has facilitated a deeper understanding of clients' behaviour, which allows more effective and precisely targeted campaigns, thus enhancing their efficiency. Furthermore, the integration of externally originated feedback, supported by BDAC, has empowered the firm under study to introduce offerings that directly address client-driven needs, thereby mitigating the risks associated with new ventures. However, perhaps the most intriguing application of BDAC from a commercial standpoint is the ongoing process of leveraging these capabilities to play a key role supporting the structural business objective of expanding within the Iberian market.

In the realm of Operations, BDAC has been instrumental in driving enhancements that resonate strongly with ambitious goals of operational efficiency. These advancements have even had a tangible impact on cash flow, facilitating improvements in billing timings. Furthermore, such capabilities have proven its value while supporting answers in a challenging regulatory context. Notably, the most unexpected innovation emerged in the form of a shift in workdays, which, at the time of the interviews, had been implemented only in rural areas but was under consideration for broader geographical application. It's noteworthy that this alteration in workdays, based on available insights, did not have a negative effect on client satisfaction. On the contrary, the ongoing integration of BDAC is perceived as supporting improvements in client satisfaction.

The most distinct benefits arise from the efforts of teams within individual segments. It can be argued that businesses reap more substantial benefits from BDAC when the teams formulating solutions are intimately connected with, if not integral parts of, the respective business sectors. This outcome may be attributed to the heightened availability and engagement of such staff. However, the recurring emphasis on the need to merge technical expertise with business acumen offers a compelling rationale for this observed impact as it more natural that segment specific teams can more easily integrated expertise of both natures. Additionally, the services provided by the Data Office, which ensure data availability for the segments, function as pivotal facilitators, guaranteeing organizational

accessibility to data for those that can better derive value from it. This, to some extent, can be framed as an effect of data democratization.

4.3 Case Study 3 – Insurance

Introduction

The third case study focuses on an insurance firm that has a substantial presence in the Portuguese insurance market. The firm's enduring dominance in the market has led it to secure a significant share. Furthermore, allowed the development of an extensive network of agents and preferred providers with nationwide reach, which is particularly relevant in the insurance industry. It is worth noting that this firm operates through a mix of partnerships and direct service delivery, which include the already mention network of partners and suppliers but also firm-owned stores and group-owned service providers. An example is the fact this firm owns automobile repair shops. The study's scope of collaboration of business areas includes the operational activities of automotive and health, the marketing department, and the firm’s most extensive regional commercial unit.

The data collected throughout the study suggests that the insurance company’s principal business objectives are centred on securing robust financial performance, fulfilling regulatory standards, and achieving customer satisfaction. Efforts to enhance financial health were identified, with initiatives focusing on both cost reductions and sales increase, in the case of the latter often via product diversification. Compliance with mandated response times emerged as a priority, reflecting the firm’s commitment to regulatory conformity. Customer satisfaction was recurrently emphasized, especially within the operational segments included in this research. It was observed that BDAC are employed by the firm to achieve benefits closely aligned with these strategic objectives, a topic that we will further elaborate.

The collaborative agreement allowed the involvement of key professionals from the firm, providing a multifaceted perspective on the adoption and application of BDAC. The participants from the firm included:

- The Director of Advanced Analytics and Artificial Intelligence, subsequently referred to as the Analytics Director. This individual is responsible for leading the development and promotion of both advanced and traditional analytical solutions within the firm.
- The IS/IT Director, whose responsibilities encompass the delivery of traditional analytics and the supervision of data governance across the firm.
- The Automobile Operations Manager, subsequently referred to as the Auto Manager. This manager oversees the segment dealing with automobile insurance-related tasks.
- The Health Operations Manager, subsequently referred to as the Health Manager, in charge of managing the segment that handles tasks related to health insurance.
- The BI Manager of Marketing, subsequently referred as the Marketing Manager, who leads the analytical team within the marketing department.
- The South Commercial Director, subsequently referred as Commercial Director, who directs commercial operations involving both partners and company-owned outlets in the southern half of the country.

The input from these participants allowed a multidimensional view of the firm's adoption and application of BDAC in various operational and strategic contexts.

Big Data Analytics Capabilities

The firm studied has a substantial customer base, a fact shared by the Commercial Director:

> *"The company as a whole serves approximately 2,300,000 clients, of which around 2,000,000 are individuals and about 300,000 are businesses".*

Hence, it is unsurprising that customer data emerges as a critical data source. Additionally, the volume of daily transactions related with serving this client base

generates a significant amount of data. The Analytics Director emphasized the strategic initiatives being undertaken:

> *"We have been implementing extra processes aimed at gaining a deeper understanding of our customers."*

This statement indicates a concerted effort to enrich customer data with behavioural data. Complementing this approach, the Marketing Manager mentioned:

> *"We also leverage data from surveys and market studies to draw out market trends and insights".*

This quote highlights the organization's efforts to enhance the quality and scope of data available for analytical purposes.

The organization for leveraging BDAC within the company is twofold. There is a more traditional approach to analytics led by the IS/IT department, which is responsible for integrating data and make it available to relevant stakeholders. This is supported by an architecture that centralizes the data created by the company's operations, fundamentally originated in business support systems, as mentioned by the IS/IT Director:

> *"We have an architecture that integrates all the information relevant to our company's activity, from business support systems to our data management platforms".*

Different activities of the company access this data that is made available for consumption, some through reports developed by the IS/IT department, while others built upon the data to fulfil specific needs. An illustrative case of this added analytical layer is the Marketing department's BI team, who generates insights from the data provided by IS/IT. Moreover, the incorporation of a dedicated Advanced Analytics division expanded BDAC within the firm. This team collaborates closely with various segments to conceive

tailored analytical solutions that addresses specific business requirements. To do so, they rely on data supplied by IS/IT and, when needed, external datasets.

When discussing the obstacles blocking the full potential of BDAC, diverse challenges were highlighted by the interviewees. The Commercial Director underscored data quality concerns, noting that, despite automated analytics generation, it is the business experts who can discern anomalies, underscoring the importance of domain knowledge in recognizing data inconsistencies. This may tie into reported issues of manually controlled data sources that are susceptible to human error. Moreover, both the Marketing Manager and the Health Manager identified the complexity of products as a barrier to BDAC efficacy. Additionally, the Marketing Manager noted that prioritizing tasks, due to some shortage of technical staff, sometimes resulted in the delayed integration of new data sources.

Technological challenges were also mentioned, including the initial underperformance of certain analytical models, which, as anticipated, improved over time due to the iterative nature of machine learning. Another technological challenge involved integrating advanced analytics solutions with existing internal applications. Still, addressing integration challenges, the Analytics Director reported a significant improvement:

> *"From a few months ago, we began to provide our models via APIs built by us".*

This initiative appears to have eased integration processes, consequently alleviating some of the constrains originated by the response capability of the IS/IT function.

In addressing the challenges associated with data analytics, the Marketing Manager highlights the difficulty of retaining data professionals:

> *"There is undeniably a retention challenge at hand, not only in recruitment but also in maintaining staff, given the current market situation where such profiles are in short supply and demand substantial salaries".*

Moreover, the operational and commercial segments of the firm employ individuals with specialized technical skills, indicating that BDAC capabilities are not only technically assured by the IS/IT and Advanced Analytics teams, but are also complemented by segments staff. Illustratively, the Health Manager noted:

> *"We have personnel who continuously enhance their qualifications, including training in SAS".*

This reflect a commitment of the firm to professional development of staff that operates under the scope of BDAC. Notably, the development of a workforce versed in both technical and business acumen is unanimously deemed "fundamental." This sentiment is shared by the Marketing Manager, the Health Manager, and the Auto Manager, underscoring the strategic importance of such dual expertise within the firm.

The firm's technological capabilities identified vary depending on their origin. Traditional analytics, for instance, are mainly centrally developed by the IS/IT department to address segments demands. The IS/IT Director summarize this approach:

> *"We are still in a vision that is very segmented according to the needs of each business direction, each of the processes, and working that information in the area of information systems. We use technologies such as SAS, Microsoft, Oracle, etc. to perform this manipulation".*

However, there's a transformative shift underway, steering towards a more innovative and integrated data strategy. The IS/IT Director delineates this change:

> *"And my area is currently taking a step which is to start working a bit in reverse; instead of being guided by the various needs of different departments, we are working from a data hub perspective, where we identify the various information domains and we are creating in the data hub these various domains where data is persisted and stored and where, in an almost self-service fashion, we then equip the organization with tools to explore this data".*

This evolution shows a concerted move towards data democratization within the firm. The intent is to identify and manage data that truly adds value to the organization, ensuring accessible and efficient data utilization. The IS/IT Director emphasizes the importance of this strategic change:

> *"I think the stage we are at is this one, which is to understand which data can add value to the organization, it's really about empowering the democratization of access to this information to maximize the benefit we get from it, but we also have to be very careful not to hoard data that really isn't relevant and won't bring value. And there has to be a much closer dynamic with the areas".*

This approach not only calls for a selective choice of data but also points out the necessity of aligning closely with the diverse business segments to truly leverage the potential of the organization's data assets.

Advanced Analytics solutions were found to often follow a more targeted pattern, with specific, tailor-made solutions addressing very specific needs of different segments. These solutions range from models that evaluate the network of medical providers for health insurance, directly supporting Health Operations in decision-making processes, to solutions that automate the processing of accident reports in around 50% of cases. This automation allowed automobile operations to change their operating model as will be further developed in the next section of this document.

Additionally, these solutions aid in developing new offerings, as was the case of the one related with pets, by identifying a network of providers, making the service launch viable. The pattern suggests that these technologically more advanced solutions based on both internal data (the same as those used in traditional analytics) and external data tend to have more specific applications. They do not exhibit the same potential for democratization as found in traditional analytical solutions. However, they share the common need for collaboration to ensure the combination of technical skills with relevant business knowledge. This necessity was emphasized by the Analytics Director when asked how they ensured knowledge to develop their solutions:

> *"I would say that the answer is very simple, a multidisciplinary team. Therefore, there is no project, and this is even something we want to make clear from the first day, which is, data scientists do not have, nor do we claim to have all the business knowledge. On the contrary, it is the technical component, the component of how to find a solution. Those who understand the business, who know the pains of the processes, who feel the difficulties, are the business directors".*

The topic of multidisciplinary teams is a dominant theme, which we will further discuss in subsequent sections of this document.

Business Benefits

The participants engaged in this research unanimously recognized BDAC as an enabler of business benefits. Matching the findings from other case studies included in this research, the benefits identified predominantly align with themes of efficiency and effectiveness. To gain a more detailed understanding of these benefits and the mechanisms of their realization, we developed a detailed analysis of how they are reached within each studied segment. This analysis will be structured employing the benefits management framework that this study has adopted.

As delineated in the introduction of this case study, the company's business objectives include achieving a solid financial performance, fulfilling regulatory standards, and enhancing customer satisfaction. The business benefits we will examine have been identified as directly serving these objectives. This trend is consistent with other firms included in this study; however, this company distinguishes itself with a marked commitment from senior leadership to capitalize on these capabilities. For instance, when inquired about the alignment of BDAC investments with business objectives, the IS/IT Director stated:

> *"I would say that they are aligned with the strategy. It is part of our strategy, and we are currently at the stage where we aim to define measurable objectives that reflect the results of that strategy".*

It is also noteworthy that multiple interviewees frequently mentioned the CEO, indicating a significant level of engagement with BDAC investments at the highest level of the company's management.

In the area of automobile operations, the IS/IT enablers identified consist of access to several dashboards and a solution based on a series of machine learning models. Regarding the former, the IS/IT department provides dashboards built with data originated from the corporate data warehouse. These dashboards are extensively utilized across the organization, with some being the result of collaborative efforts between the automobile operations segment and the IS/IT teams. As for the latter, there are a set of machine learning models designed to semi-automate the processing of automobile insurance claims. These models, developed together with the centralized advanced analytics team, integrate with the firm's digital platforms, facilitating the online submission of claim-related documentation by clients.

The collaboration of multidisciplinary teams has been identified as an enabler for dashboards development and usage, ensuring they are more aligned with the specific needs of this segment, this is also the case of the machine learning model-based solution as it was also the result of collaboration efforts. Through the synergy of such teamwork, the firm has been advancing its decision-making processes by more effectively tracking the achievement of its objectives and continuous improvement initiatives. The Auto Manager highlighted this when discussing access to dashboards:

> *"Yes, we have them for monitoring quantitative objectives. We utilize them to grasp the progress or to monitor costs and the frequency of claims, to determine our direction".*

Moreover, this collaborative spirit, particularly with the Advanced Analytics team, has facilitated the creation of models that have transformed the processes of processing claims and the automatic scheduling of appraisals. At the time of this interview, approximately 50% of cases were being processed automatically, with expectations for this figure to increase. These advancements are achievable because clients have been

guided and equipped to submit documents in a manner that aligns with this automated process. The automation of responses has allowed the internalization of the full operation and subsequent termination of a contract with a service provider.

The partially automated claims reporting process and operation internalization have led multiple benefits for this insurance firm. Initially, the operation in question relied on an external supplier, but gains in efficiency have allowed the firm to transition this function to in-house which also assured the know-how is kept indoors. The Auto Manager succinctly highlights these efficiency gains:

> *"Previously, it took us an average of 40 to 45 hours to open a case, accounting for overnight time and excluding only holidays and weekends. Now, the average time has been reduced to 6 hours, including those claims received via email and processed through a collective inbox".*

Additionally, the implemented automation has facilitated increased use of the company's car workshops, and, when necessary, preferred external workshops. This not only yields financial benefits but also provides customers with the added value of a courtesy vehicle. As the Auto Manager elaborates:

> *"Established agreements extend beyond mere discounts, allowing workshops to offer courtesy vehicles, thus transferring the expense to the workshop and saving us the cost of providing a replacement vehicle. This is inherently advantageous".*

The automated scheduling of appraisals has contributed to internalizing the operation and, alongside the automated response system, has enhanced the firm's compliance with legal response times mandated by the industry regulator – a point of concern, as the Auto Manager indicates:

> *"Our operations are legally bound to specific deadlines. A decree-law mandates that an insurance company must initiate the claims process, including contact and appraisal scheduling, within 48 hours of receiving notification, with the entire process reported cumulatively each year".*

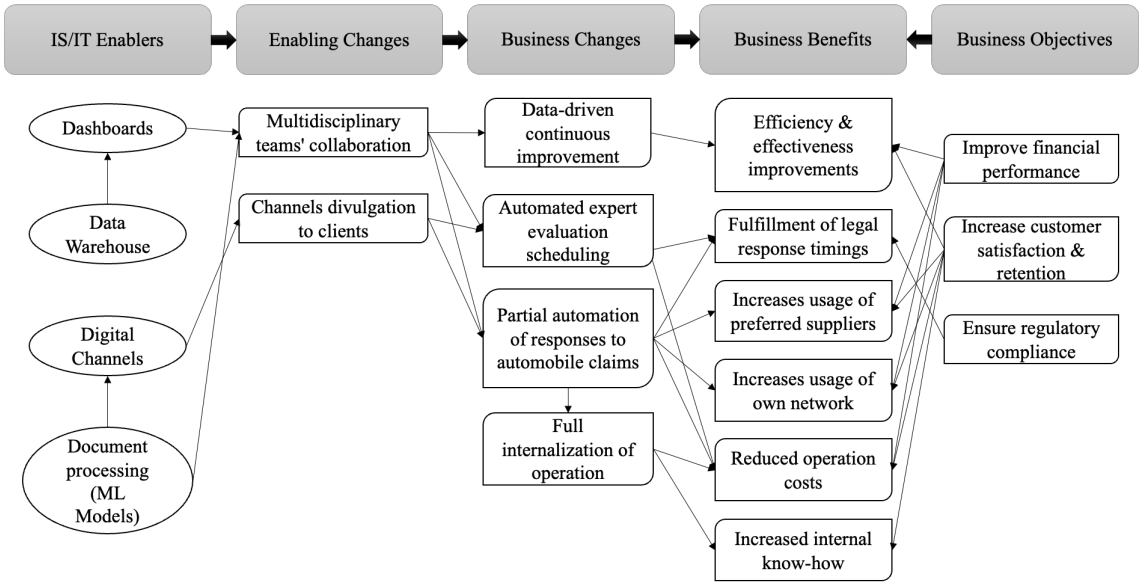
Furthermore, the operation running only with own staff is seen as more advantageous to ensure proper customers' treatment.

Moreover, the shift towards data-driven decision-making has facilitated the implementation of several minor initiatives that target efficiency and effectiveness improvements, furthering the company's objective to improve financial performance. Additionally, many of these benefits directly influence customer satisfaction and retention. This correlation is illustrated in a story shared by the Auto Manager:

> *"When we first implemented this project and began to follow up on initial cases, we listened to customer feedback. One customer, after an accident, was advised by his broker on how to report the incident digitally. Shortly after, while still at the accident scene, he received an SMS confirming his case was open, with an appraisal scheduled for the next day. This greatly enhanced our customers' perception of our service, offering them peace of mind that we are proactively managing their situation, and has indeed led to a reduction in the overall claims settlement time".*

Figure 14 represents the benefits dependency network for the solutions that were found to support this operation.

Figure 14 –Benefit Dependency Network of Automobile Operations Analytical Solutions



In the operational activity's context, this research was also directed to health operations. The IS/IT infrastructure supporting this segment is similar to what was found in automobile operations. They benefit from dashboards developed collaboratively with the IS/IT department, tailored to their specific requirements. Specifically, to this division, however, is the inclusion of data analytics activities in the scope of a planning and control team that is part of this operation. Reflecting a more specific investment in the approach to data analytics. Moreover, health operations are served by machine learning models that are designed to automatically process documents, such as reimbursement and provider invoices. This automation signifies a step towards increased efficiency and the leveraging of advanced technological solutions within the health operations of the firm.

The enabling changes observed in the health operations reflect a pattern similar to that seen in the automotive sector. Specifically, the collaboration between operational teams and the specialized technical teams within the IS/IT and advanced analytics departments was seen as key for the successful execution of these initiatives. To fully leverage the machine learning models, it was imperative that both clients and suppliers were informed about, and starting using, the digital submission channels established for this purpose.

Technical training emerged as a crucial element, especially concerning the analytical tasks performed internally within the operations. The Health Manager elucidates this:

> *"The team responsible for management control, who also assisted with the model's implementation, are not only academically qualified in management, but they have also proactively upgraded their skills over time, including undergoing training in SAS".*

This insight shows the perceived importance of combining business expertise with technical proficiency within the context of BDAC. The combination of technical training with collaboration with centralized technical departments led to significant process improvements. Operations management has transitioned to a more data-driven approach. The manager of this operation emphasizes the critical nature of these capabilities:

> *"In such a dynamic world, the absence of this information can lead us to make irreversible erroneous decisions".*

Additionally, quality control and capacity planning have been enhanced by BDAC, also enabled by both the collaborative efforts and the technical training provided.

A particularly transformative outcome has been the automation of the reimbursement and provider invoice processing, which led to an array of benefits. One notable benefit, as the Health Manager remarked, is the headcount reduction:

> *"There is indeed a clear freeing up of FTEs which we will continue to pursue, in collaboration with the advanced analytics team in implementing and training new invoice reading models".*

The advantages of this automation extend to improved response times, an increased capacity to manage relationships with clients and suppliers, and improved customer satisfaction. As noted by the Health Manager:

> *"We have even managed to improve the customer relationship process and better support customers and providers. These are the two main areas we have been able to measure at this moment, and we will continue this effort".*

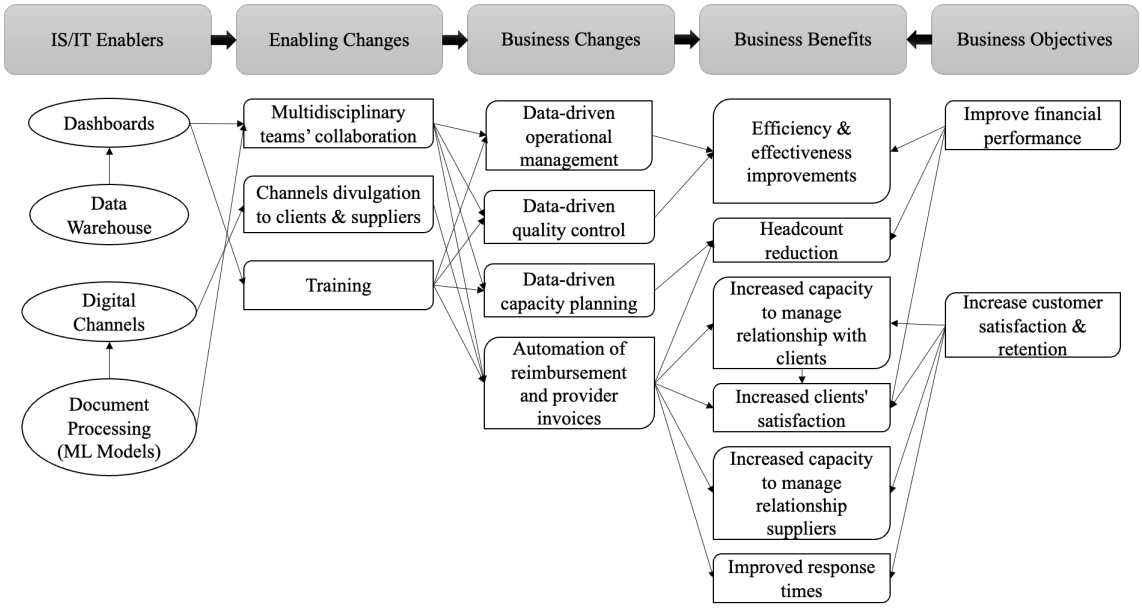
Additionally, the advanced capabilities in quality control and data-driven decision-making are enabling several minor improvements in processes that lead to increased efficiency and effectiveness within this operation.

These advancements directly contribute to achieving business objectives, notably in enhancing financial performance and improving customer satisfaction and retention. The Health Manager's words underscore this perception:

> *"We have received a wealth of positive feedback from our clients, particularly large corporations, and our entire commercial network. The absence of issues in the commercial claims area signifies that our operations are running smoothly, which is excellent news".*

Figure 15 represents the benefits dependency network for the solutions that were found to support this operation.

Figure 15 –Benefit Dependency Network of Health Operations Analytical Solutions



In the context of commercial operations, especially in relation to IS/IT enablers, similar to other operational segments previously examined, the commercial sector uses dashboards developed in collaboration with the IS/IT function. These dashboards are supported on data from the corporate data warehouse. Additionally, machine learning models are used within commercial operations, which are developed in collaboration with the advanced analytics team. These models, along with the dashboards, are the result of collaborative efforts that combines technological proficiency with in-depth business understanding of commercial activities. This collaboration stands out as an enabler that allowed transformative changes under this context. Moreover, data quality initiatives also play a key role as enablers. To this regard, the effectiveness of these initiatives varies depending on the quality of the data, a challenge articulated by the Commercial Director:

> *"The quality of our database is not quite where we want it to be. This is partly due to the age of our portfolio. We possess data spanning many years, a time when contact details like mobile numbers or email addresses were less common or unused. Although there has been improvement over time, it remains a challenging endeavour. We can't always reach all customers due to the diversity of our distributors and distribution channels".*

Collaborative efforts, when facilitated by quality data, have led to several process transformations within the firm. Sales operations management is increasingly reliant on data, with some decisions even being automated, as highlighted by the Commercial Director:

> *"We've been implementing mechanisms for procedure adaptation based on accurately mapped data and processes, enabling binary responses – yes or no. When necessary, we intervene, but there's a distinct trend towards simplifying and streamlining processes. As the accuracy of automated decisions improves, this trend becomes more pronounced annually".*

Additionally, the sales processes have evolved to become more data-driven, specially laying on an enhanced client understanding. The Commercial Director elaborates:

> *"Understanding our customers allows us to be much more effective in business dealings, offering personalized engagement. For instance, acknowledging a customer's family details, sourced from our data, makes them feel valued and fosters an emotional connection".*

Furthermore, the commercial segment leverages BDAC in developing up-sell strategies, particularly using propensity models. The approach to managing product usage has also undergone a shift, which is seen as essential for customer retention, as shared by the Commercial Director:

> *"Our aim is to gauge the frequency of service usage by health insurance customers, including telemedicine, home medication delivery, or the Vitality app in our health product. This insight is vital because if a customer doesn't use the product, often due to a lack of claims, they might perceive it as unnecessary."*

The process modifications implemented in the firm have supported the reaching of several business benefits, derived from BDAC. The Commercial Director highlighted the importance of data in driving improvements:

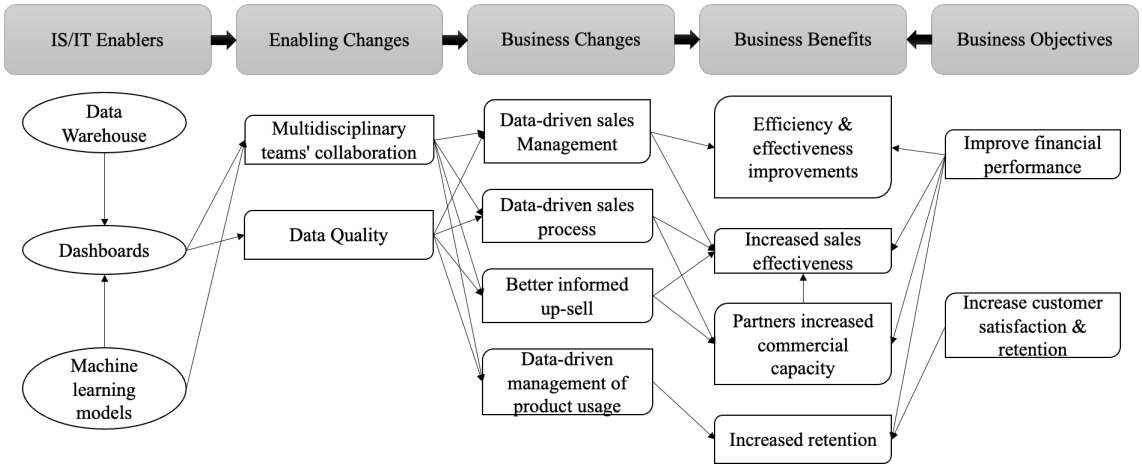
> *"I often say that what isn't measured can't be improved, and indeed, that is a central issue, so to speak, of what data represents".*

So, it is not to wonder that several minor efficiency and effectiveness are identified as benefits, these gains also derive from the allocation of a dedicated staff member that continuously enhances the analytical solutions that serve this segment. Furthermore, sales effectiveness has seen an increase, largely attributable to more data-driven management and refined up-sell strategies. This improvement is partly due to the increased commercial capacity of the partners, as leads generated through BDAC are distributed irrespective of the channel and made accessible via a platform for mediators to initiate contact, as explained by the Commercial Director:

> *"These leads are worked on independently of the distribution channel and are delivered through a platform so that the mediators can make the contacts".*

Lastly, the revised approach to managing product usage supports improvements in client retention. This not only enhances financial performance, mirroring the impacts of other benefits previously mentioned, but also contributes to customer satisfaction and retention. These changes, collectively, show the impact of BDAC in optimizing both operational efficiency and client relations. To allow a better understanding, figure 16 represents the benefits dependency network for the solutions that were found to support commercial operations.

Figure 16 –Benefit Dependency Network of Commercial Operations Analytical Solutions



The Marketing department of this insurance firm was also included in this research. This segment stands out from the others in its greater independency as compared with others that relied more intensively on collaboration with the IS/IT and advanced analytics areas. So, this business activity has a significant contribution to the overall BDAC landscape within the company. To technologically support their efforts the Marketing area uses not only some dashboards developed by the IS/IT department, and data from the corporate data warehouse, but has also created their own analytical models, such as those for determining the next best offer and those that enable personalization strategies. It is noteworthy that some of the more sophisticated models were developed in collaboration with the advanced analytics team, and that those models are integrated in the firm's digital channels maintained by IS/IT team.

Within the marketing department the role of multidisciplinary team collaboration is essential for enabling effective use of technology. The Marketing Manager emphasized the importance of leveraging work from other departments:

> *"We utilize the customer lifetime value, created in a different department, as an input for our segmentations. Similarly, we benefit from the advanced analytics team's expertise in developing propensity models, enhancing our campaign targeting strategies".*

This collaborative approach, coupled with the emphasis on digital channels for customer interaction, has facilitated various process improvements, such as improvements in customer journey mapping and more personalized client communication which are particularly relevant as the Marketing Manager highlighted their omnichannel strategy:

> *"With the multitude of communication methods now available, we adopt an omnichannel perspective of the customer".*

Consequently, the development of marketing campaigns has become more data-driven, also due to the global relevance of data-driven decision-making that was stressed out by the manager:

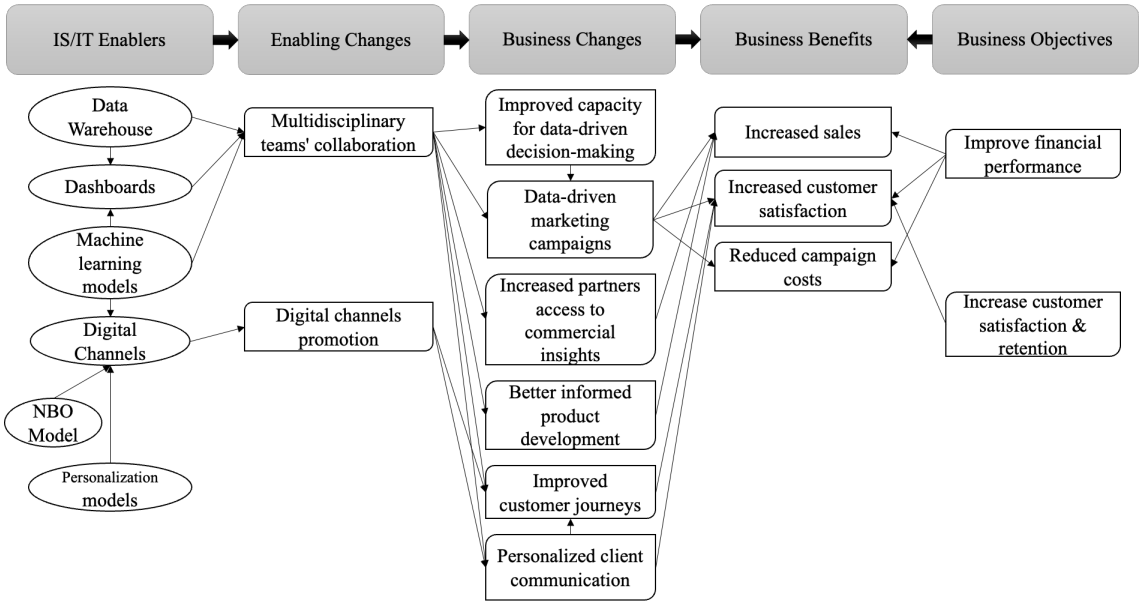
> *"Our focus is on extracting value from all our activities, underpinning our fundamentally data-driven approach to decision-making".*

In addition, product development has also evolved to rely on BDAC, and partner relationships changed as they now have access to analytical insights, as noted by the Marketing Manager:

> *"But what we do here is provide leads or commercial opportunities, meaning we centrally identify that this customer has a very suitable profile for this product and we pass this information on to the network so that they can use this intelligence to finalize the business deal".*

The business process changes identified in the study have led to tangible benefits for the firm, including increased sales, enhanced customer satisfaction, and reduced campaign costs. These outcomes demonstrate a clear alignment with the firm's business objectives: to enhance financial performance and improve customer satisfaction and retention. Illustrating these interconnected benefits and their underlying drivers, Figure 17 provides a visual representation of the benefits dependency network.

Figure 17 –Benefit Dependency Network of Marketing Analytical Solutions



Future Plans

This study found that the different segments of the firm under analysis have distinct yet complementary future plans for BDAC, unified by a collective focus on developing these capabilities. For the commercial operations, BDAC is viewed as a strategic tool to minimize manual tasks and extend the automation of decision-making processes across various functions, and they want to further explore this path already mentioned in this research. In pursuit of operational cost reduction – a key strategic goal of the company – commercial operations are exploring innovative ways to optimize their processes. The Commercial Director shared an example of their forward-looking strategy:

> *"In line with the company's need for cost reduction in the coming years, a core corporate strategy, I plan to collaborate with the Advanced Analytics team to geographically map our mediation areas. This process will involve georeferencing the addresses of our mediators and aligning our business allocations to stay within a maximum 20 km radius to minimize travel. Ideally, we aim to further streamline our operations".*

This approach highlights the expectations that BDAC support this segment in both automating and streamlining processes, and in supporting improvements in operational efficiency and cost-effectiveness.

The marketing team shared they have a substantial backlog of solutions awaiting development, though they were not explicit about which solutions are those. However, the Marketing Manager was clear on the anticipated impact of this backlog on team dynamics and resource allocation:

> *"Based on our current needs and the extensive range of project topics in our backlog, we recognize the importance of having adequate team capacity to undertake these projects. Often, it becomes apparent during the planning phase that our team lacks sufficient members to effectively handle the demands of specific projects we wish to pursue. Consequently, this realization typically leads us to expand our team, adding more members to adequately address the scale and scope of our project needs".*

This is particularly relevant because shows a probable intention to hire new staff, although, as mentioned before, this segment sees talent attraction and retention as challenging.

In the operational segments of automotive and health, there is a trend towards increasing automation, particularly by increasing the number of automatically processed documents. This intention was mentioned by both the Auto Manager and the Health Manager, highlighting a strategic focus on enhancing efficiency through technological advancements. The Auto Manager emphasized the ongoing nature of this development:

> *"We are committed to a continuous process aimed at automating invoice reading and other processes. This journey is far from complete; we are actively shaping our path as we proceed".*

Similarly, the Health Manager outlined specific future plans:

> *"Our next project is geared towards expanding our document reading capabilities. We're still in the preliminary phase, but it involves automating the reading of car workshop invoices. The goal is to extract key information, which, when cross-referenced with the data in our system, allows us to automate confirmations and subsequent payments".*

These insights from both managers reveal how both these areas have similar expectations regarding these capabilities.

The future perspectives shared by the Analytics and IS/IT Directors converge on a theme which is optimizing the organization's utilization of BDAC. Both leaders share a commitment to a decentralized approach, aiming to democratize data access across the organization. However, it is evident that the path to achieve that goal is still under development. The Analytics Director emphasized how he believes that there is still a much to be done:

> *"Therefore, I believe in the decentralization of Analytics, involving several steps. This includes developing analytics tools designed for business users, not just IT experts. This shift, initiated a few years ago, has yet to be fully leveraged by our organization in the realm of analytics".*

Complementing this viewpoint, the IS/IT Director discussed the adoption of the hub and spoke model, a strategy still in early stage within the organization:

> *"We began by focusing on the associated metrics, adopting the hub and spoke approach. This involves expanding, identifying, and increasing the number of spokes – the operational extensions – within our organization".*

The subsequent sections of this document will further develop this topic.

Discussion

The role of multidisciplinary collaboration in this firm can be argued to be a relevant factor in harnessing the potential of BDAC, both in recognizing opportunities and in their execution. When discussing innovation in the context of Health Operations, the Analytics Director provided a tangible example:

> *"A direct example I can cite is the automation of our current reimbursement process. This initiative stemmed from a comprehensive analysis of the volume of health reimbursement processes we handle and the workforce allocated to them. We use a dashboard to assess consumption patterns, which led us to develop a solution aimed at automating these processes and reducing associated costs. The genesis of this solution was during a brainstorming session where the need for an invoice reading model was identified and subsequently developed".*

This case exemplifies how collaboration is a relevant enabler of the realization of benefits from BDAC.

However, collaboration alone seems not to be enough as significant efforts have been made to enhance the technical skills of staff in business activities. While these skills are necessary for the technical aspects of their roles, they are also relevant to ensure fruitful interactions with teams more technically focused areas. As noted by the Health Manager regarding the importance of training:

> *"They were quite comfortable with information management, data management, and besides that, what we find very important is indeed this interaction with other areas of the company that are actually, whose core activity is analytics."*

This highlights the importance of ensure individuals that combine business acumen and technical expertise to maximize the potential benefits of BDAC.

The collaborative efforts between business and technical teams within the firm have led to benefits extending beyond mere efficiency improvements, such as the automation

of document processing in operational areas. A relevant example of this collaboration is the development of a new pet insurance product. The Commercial Director shared some insights of how this product was developed:

> *"In collaboration with the Advanced Analytics Team, we were able to ascertain the number of veterinary service providers in proximity to our clients. This insight was crucial because, lacking our own veterinary network and offering a product primarily based on reimbursements, it was essential to ensure accessible services for our clients – services provided not by us, but by external providers."*

This example illustrates the impact of having a technically solid team capable of handling diverse data sources in an agile manner. It enabled the launch of a unique insurance product, distinct from existing offerings, informing the establishment of relationships with a new network of suppliers, previously unfamiliar to the firm. This example highlights the innovative use of BDAC and underscores the strategic value of cross-functional collaboration in expanding the firm's service portfolio with a differentiated product.

Data democratization has emerged as a key theme in this case study, as well as in this research in general. The Health Manager succinctly articulates her view of this concept:

> *"We employ common data for various purposes – from team sizing to pricing forecasts and portfolio growth. This cross-functional data is democratically accessed and used according to the specific needs of each department".*

This perspective is shared and expanded by the Marketing Manager:

> *"In marketing, we work with publicly available company data accessible in data marts. We also incorporate insights and model results from other departments into our strategies".*

Worth noting that not only different segments of the firm have access to analytical data made available centrally by the IS/IT function, but also as is quite clear in the case of Marketing, there is a sharing of analytics produced in a distributed manner by other business activities.

Expanding beyond internal operations, this strategy of data democratization extends to the firm's network of partners. By sharing analytical insights with external stakeholders, the organization embraces a more open and collaborative approach with its surrounding environment. This practice aligns with observations from other case studies in this research, where BDAC is not just an internal tool for optimization but also an enabler of communication with their surrounding environment.

The data from the insurance company suggest that BDAC are a crucial source of competitive advantages. This claim is reinforced when evaluated through the VRIO framework, which provides a structured analysis of the company's strategic use of BDAC. Regarding value, the large client base in the market this firm operates provides value as mentioned by the Marketing Manager:

> *"The information we have about our customers is clearly a competitive advantage".*

This customer data combined with extensive supplier data, supports an advantageous positioning of the firm in the market. Concerning rarity, initiatives such as the identification of suppliers for the pet insurance offering demonstrate rarity, also the models that have been implemented in Automotive Operations are seen, while compared to competitors, as a source of rarity as can be inferred from the words of the Auto Manager:

> *"This year we are looking to improve through new models. Our commercial area felt that we differentiated ourselves".*

Regarding imitability, the Health Manager believes the level of service achieved with BDAC is difficult to match:

> *"Of course. Now looking just at my area. The advantage we have is better customer service, very satisfied customers. And this is crucial when contracting insurance and even for renewals".*

Finally, organization while it is probably the dimension that is currently more prone to change in the short-term, the creation of the Advanced Analytics area can be argued that have been effective in facilitating the implementation of differentiative solutions under the scope of BDAC, as it is also the case of IS/IT area in the case of more traditional analytical solutions. Thus, in can be argued that BDAC has been providing competitive advantages, which is solidified by the external award granted to the solution implemented to the Automotive Operations, which can be seen as an external recognition of the differentiation achieved. Furthermore, data democratization within the company emerges as a significant enabler by allowing widespread access and utilization of data across different departments, improving the firm's overall ability to leverage BDAC for strategic advantages.

This firm has demonstrated a strong commitment to advancing its BDAC, particularly through the establishment of the Advanced Analytics area. This initiative, coupled with significant investments in specific solutions, reflects a relevant engagement with BDAC, as explored throughout this case. However, from an organizational and architectural standpoint, the firm at the time data to this study was collected was re-evaluating its approach to BDAC. A key aspect of this re-evaluation is the firm's inclination towards data democratization. The IS/IT Director's statement clarifies this perspective:

> *"Therefore, I believe in the decentralization of Analytics, and then there are many steps, these are analytics production tools that are made for business people and not for IT experts, and this change that happened a few years ago and that I also think our organization has not yet been able to fully take advantage of the benefits it brought to this analytical world".*

This quote underscores a recognition of the need to change to better capture the potential of these capabilities.

While contemplating future strategy, the firm appears to be considering a blend of approaches as elaborated by the IS/IT Director:

> *"I think there are many steps here, and we are trying to design our strategy. We have been looking at data mesh and believe that some aspects of it may not yet align with our culture, with our maturity. We want to take advantage of many things, but what I think is that we will end up with a mix of various approaches. Between the hub & spoke, data mesh, more centralized things, we are even making a significant effort to have more knowledge about all these approaches to then correctly adapt the advantages of each of these approaches".*

This indicates a movement towards a hybrid model, combining elements of centralized and decentralized approaches. While the definitive strategy is still in development, it's arguable that a form of hybrid approach already exists within the firm, even if in part informally. This is evident in the coexistence of centralized efforts and decentralized initiatives across different segments in relation to BDAC, as the ones presented in this document.

Conclusions

In addressing the central research question of this study, "How do firms benefit from big data analytics capabilities?" it becomes evident that the insurance firm in question has achieved significant business benefits from its investment in BDAC. These advantages can be broadly categorized under gains in efficiency and effectiveness. A closer examination of different segments within the firm reveals specific areas of impact. Notably, the investments in both the Automotive and Health Operations segments have demonstrated a strong emphasis on automation. This focus has brought substantial operational benefits, such as reductions in staffing costs. Although the increased capacity was not fully used to cut staff but has also been redirected towards strengthening

relationships with clients and suppliers, which are more data-informed due to BDAC. Particularly significant regarding clients is that the improvements in operational performance enabled by automation have had a direct positive effect on customer experience. Increased efficiency and responsiveness in services such as claims processing and appointment scheduling contribute to a smoother, more satisfactory customer experience. Thus, the firm's strategic investment in BDAC in the operations segments included in this study, has not only optimized operational processes but also played a relevant role in enhancing customer relationships, which can be argued that is an effect of increased openness to the external environment facilitated by BDAC.

The Marketing and Commercial sectors were also found to have direct benefits from BDAC, particularly in ways that improve the customer experience. These capabilities are used to gain a deeper understanding of customer behaviours and preferences, and those insights allow the optimization of customer journeys, ensuring they are more closely tailored to meet individual client needs. Furthermore, BDAC also enabled cost reductions, which is exemplified by the ability to execute better targeted marketing campaigns. While cost reduction is a notable benefit, the primary focus in these sectors remains on increasing sales. In this regard, BDAC has been used to support the development of new products both by informing customer needs and by supporting the identification of potential suppliers. Furthermore, another relevant aspect of BDAC's contribution is how these capabilities support the network of partners by providing them insights obtained from data analytics and allowing them to some degree to benefit from the data democratization seen in this firm.

For the firm to achieve business benefits from BDAC, the collaboration of multidisciplinary teams has emerged as a key enabler. This is particularly evident in the collaborative efforts between business teams and centralized technical teams within the IS/IT and Advanced Analytics departments. Moreover, despite certain segments having their own technically skilled staff capable of developing analytical solutions within the context of BDAC, there is the need to access data managed at a centralized level that often is of interest of different segments. This necessity has led the firm to reconsider its

operational approach and explore models such as data mesh and hub and spoke. The aim is to develop a strategy that aligns well with their specific organizational needs. While a definitive model had not been established at the time of data collection for this study, there was a strong perception of the need for a hybrid model that could balance democratized autonomy across different segments with the necessity for centralized control and oversight.

4.4 Case Study 4 – Bank

Introduction

This fourth case study is centred on a retail bank operating within the Portuguese market. While it is a subsidiary of a larger banking group, the focus of this study is specifically on its operations in Portugal, where the study participants are based. Ranked among the top five banks in Portugal, it offers an extensive array of retail and commercial financial services. The bank's operations are supported by a physical branch network and by digital channels. Increasingly, the bank is moving towards digital management of client relationships, with some clients now being entirely overseen by digital client managers. This mix of traditional and digital banking approaches positions the bank as an interesting object of study in the context of this research. Even more due to the trend towards digitalization has intensified.

As we will further explore in this case study, we observed that the bank under study aligns its business objectives with those of other firms previously examined. These objectives include improving financial performance, ensuring customer satisfaction, and adhering to regulatory compliance. Significantly, this bank demonstrates a particular focus on BDAC as means to achieve these aims. Highlighting its commitment, the bank has established a dedicated department for advanced analytics, in which the teams that handle the traditional analytics functions were also moved into.

The research collaboration protocol established with the bank enabled the participation of key segment leaders, offering a comprehensive perspective on the utilization and benefits of BDAC within the bank. The participants contributing to this study include:

- The Executive Director of Customer Management and Digital Performance, subsequently referred to as the CRM Director who also played a key role in establishing the advanced analytics area, although he no longer oversees it.

- The Analytics Director who leads the analytics, advanced analytics and risk models divisions.
- The Executive Director for Commercial Management and Effectiveness, subsequently referred to as the Commercial Director, who leads the commercial operations for both individual and corporate clients.
- The Investments Director who leads operations related with savings and investment.
- The Everyday Director who leads operations related with daily banking products such as accounts, payments, and cards.

The contributions from these diverse roles enable a multidimensional understanding of how BDAC is adopted and applied across various activities of the bank. Which support a better understating on how this bank benefits from BDAC.

Big Data Analytics Capabilities

The bank's BDAC are driven by various internal data sources, with customer data being the most significant. The Analytics Director highlighted the nature of this data:

> *"Typically, there is data related to the customer relationship and customer data, with the customer's identification not being used".*

This statement also underscores a significant focus on privacy, a subject that we will further explore in this case study. To ensure a better understanding of customer behaviour, the bank is actively seeking to improve its data gathering processes. The CRM Director shared some light on potential areas for expanding data creation, particularly in digital customer interactions:

> *"We have access to data, particularly customer data, but where that dimension is not as complete, and where there's probably an even greater dimension, is in the detail of digital navigations and all the streams of digital interaction. For example, this aspect is not yet as integrated".*

This insight reveals ongoing efforts to deepen its data sources depth to create the foundations that can enable reaching a better understanding of customer behaviour.

The capabilities identified within this bank are dual in nature, one which is a more traditional approach, and the other which take advantage of more advanced technology. The BDAC linked with a more traditional approach that materializes mostly on dashboards. These dashboards allow a 360-degree view, facilitating thorough insights as emphasized by the Investments Director:

> *"We always have dashboards with a 360-degree view".*

Additionally, there is an internal policy of 'full dashboarding' as explained by the Everyday Director:

> *"There's a group-wide principle, also applicable in Portugal, that we call 'full dashboarding' Essentially, we aim to convert all one-off analyses into recurring, business-relevant dashboards, thereby avoiding repetitive analysis. This full dashboarding concept, along with the analytical component, forms a significant part of our daily routine as product area managers. We rapidly review dashboards, monitor indicators, understand our current standing, and subsequently use this information for decision-making".*

This approach not only allows the future use of analysis but also highlights the critical role these capabilities play in the decision-making processes of managers.

Furthermore, within the context of traditional analytics, the bank is advancing its use of BDAC in innovative ways, as is the case of the harvests approach. The Everyday Director elaborates on this method:

> *"We've progressed from tactical, day-to-day analysis, like our current status or comparison with the previous month, to a more strategic 'harvests' mindset. We view our business as a series of harvests. For instance, we consider the customer base acquired in a particular month and track their progress through the*

> *onboarding process, product placement, and loyalty and engagement with the bank. Our focus has shifted from daily figures to understanding and leveraging the outcomes of these harvests for continuous improvement".*

This can be argued as an example of how there is still room for improvement and innovation within the context of the bank even when recurring to simpler technological approaches.

The bank has also made substantial investments in advanced analytics. Five years prior to the data collection for this case study, a dedicated area was established to work closely with business units in developing sophisticated analytics solutions. This effort primarily concentrates on creating models that capture customer behaviour, enabling highly targeted approaches. The Analytics Director explains their view:

> *"Each customer is unique. We utilize data to discern the differences and similarities between customers, aiming to deliver tailored services that meet the individual needs of each customer satisfactorily".*

This behavioural focus is also highlighted by the Everyday Director:

> *"We are now delving into behavioural aspects, allowing us to personalize our services completely".*

The methods through which the bank leverages advanced analytics capabilities are diverse and will be further explored in subsequent sections of this document.

There is a visible evolution and application of BDAC within the bank, yet the various business activities included in this research identify challenges. A significant challenge, as expressed by the Commercial Director, is the dependency on technical areas for data extraction, underscoring a need for an approach that would allow his segment to have an higher degree of autonomy. He believes a data lake system would allow for more user-friendly access to data, enhancing flexibility, speed, autonomy, and real-time data

availability. This demand reflects a pull for a strategy that increases data democratization as is clear in the words of the Commercial Director:

> *"One of the challenges is that I am hugely dependent on these areas for data extraction. We need to progress towards a data lake where they can deposit data, and where I, with more of a user's knowledge rather than that of a programmer or data analyst, can utilize and make use of these data as a service. With more flexibility, quicker access, more autonomy, and also more real-time data".*

The bank's ongoing migration to cloud computing is another central aspect of its current BDAC strategy, potentially resolving existing infrastructure limitations impacting digital data integration. The CRM Director notes these limitations and the ongoing efforts to integrate more digital data:

> *"For example, we are not yet working with all the digital component information due to infrastructure limitations, so we are now starting to make these connections".*

Also from a technological standpoint, the Analytics Director highlights the unique challenges of operating within a banking and group structure, where tool selection must undergo rigorous cybersecurity validation and align with the group's technology blueprint:

> *"The challenges that arise are technological or related to tools, because there is the component of being a bank. We cannot use all the tools we want because there are tools that must undergo Cyber validation and then, whenever we want to use a type of platform, we have to see if it fits within the group's blueprint".*

Data governance and compliance with data protection regulations are also cited as significant challenges, restricting data usage and necessitating careful management. Furthermore, the Investments Director brings a different perspective, emphasizing the need for more human resources to fully leverage BDAC's potential:

> *"I believe we always need more resources. Now, regarding the structure, I think things are adequate. I regret not having more availability and not having enough people. I think the challenge is always in interpretation. So, one thing is to develop, and another thing is to have the time to extract what's inside".*

Thus, both the Commercial Director and the Investments Director show signs of wanting, and necessitating, an internal increased capacity to further take advantage of BDAC.

The organizational approach of the bank in leveraging and enhancing BDAC is of great relevance in this research. The creation of an Advanced Analytics area marked a significant strategic decision. The CRM Director, who was responsible for setting up this area, provided valuable insights:

> *"The evolution was fascinating. When we established the advanced analytics department, the initial goal was to demonstrate its practical utility. Data science was trendy four years ago, but we were careful in our approach to hiring. We aimed to avoid creating a theoretical, non-impactful 'laboratory' environment. Some candidates had a very narrow perspective, which wasn't what we wanted. So, we chose a leader who was adaptable, understanding that different goals require different approaches. We began with a small team, focusing on use cases that clearly showed value".*

These insights shed light on the bank's strategy to incorporate Advanced Analytics, particularly the seek for flexibility and practicality with a focus on internal talent usage.

Moreover, while the Advanced Analytics team is a centralized unit within the bank, a hybrid operational model is employed to facilitate some level of decentralization. This model, as described by the Everyday Manager, involves collaboration between the central analytics team and individual business segments:

> *"Our approach is a blend; we operate a hybrid model where the Advanced Analytics team is the core group. They handle the specialized advanced analytics work, while the reporting and dashboarding functions are managed through a*

> *'pods' system. In this system, my area – Everyday Banking – has a dedicated pod consisting of members from both the Advanced Analytics team and my team. They hold the expertise, but my team members are trained in both data extraction and report generation".*

However, it was noted that not all segments have the resources to fully engage in this 'pods' model. Despite this, there is a degree of direct involvement and collaboration across all studied activities, as business knowledge is considered essential to develop analytical solutions that support the fulfilment of business objectives. This collaborative dynamic and its implications on the bank's operations and strategies will be further explored in the subsequent sections of this document.

Business Benefits

The research participants, representing diverse areas of the bank, uniformly acknowledged BDAC's role as an enabler of business benefits. Consistent with the findings from the other case studies included in this research, the general benefits attributed to BDAC in this bank align with efficiency and effectiveness improvements. To delve deeper into the specific advantages realized by this firm through BDAC, we will apply the benefits management framework selected to use in this research.

The identified business objectives supported by the benefits derived from BDAC align with those identified in other case studies. These objectives include improving financial performance, improving customer satisfaction and retention, and ensuring regulatory compliance. The pursuit of improved financial performance is a natural goal for a commercial entity operating in a competitive market. This competitiveness also amplifies the importance of initiatives aimed at customer satisfaction and retention. The focus on ensuring regulations are met is also natural considering this firm operates in a market governed by both national and European regulations. It's noteworthy that there is a deliberate alignment between these objectives and the bank's investments in BDAC. As emphasized by the Investments Director, who also noted that the focus is not solely on financial metrics but also on customer-centric goals:

> *"I would say that business objectives really set the pace. I'm already considering customer NPS, so, the level of satisfaction, as a business objective. Therefore, it can't be said that it's just about the money, so to speak, but clearly about commercial objectives of being the best bank for our customers".*

In an in-depth analysis of the bank's 'Everyday Banking' business activity, which encompasses services related to accounts, payments, and cards, two IS/IT enablers emerge. Firstly, there are analytical dashboards, constructed over the bank's corporate data warehouse. Additionally, the segment employs advanced analytical models that utilize machine learning techniques to enhance and refine its services. The development, maintenance, and advancement of these technologies result from concerted collaborative efforts between the Everyday Banking segment and the bank's technically areas. The nature of this collaboration varies, dependent on the specific technological application. For traditional analytical methods the bank employs an hybrid staffing model. This model incorporates staff from both the Everyday Banking segment and technical teams. The hybrid approach facilitates the inclusion of both business acumen and technical expertise, ensuring that developed solutions are aligned with the Everyday Banking segment's operational needs and strategic objectives. Moreover, this approach guarantees that the technical solutions adhere to the bank's internal standards. Regarding advanced analytics solutions, there is a more conventional level of collaboration. In this setup, the segment identifies requirements but does not directly involve its technical staff in the development teams.

Fundamentally based on the collaborative approach mentioned earlier, this banking segment has been evolving towards increasingly data-driven decision-making. This evolution is evident from the Everyday Director's statement:

> *"A significant portion of our time is dedicated to interpreting and analysing data, as well as structuring new data to enhance our decision-making capabilities".*

A notable business change, driven by corporate policy, is the adoption of a 'full dashboarding' approach. This approach involves converting all analysis, considered

relevant for future reference, into dashboards for subsequent reuse. Moreover, the bank employs hyper-personalization strategies for managing client relations. As the Everyday Director explains:

> *"We now adopt a level of hyper-segmentation in our decision-making, previously unattained. For example, in the context of underperforming home loan production, we no longer discuss launching generic campaigns. Our strategies are now hyper-personalized, based on diverse customer profiles and model-driven insights".*

Additionally, the methodology for client contact has evolved, prioritizing interactions based on the likelihood of positively influencing the NPS, as stated by the Everyday Director:

> *"We focus on customers where contact is most likely to enhance the relational NPS".*

Finally, in line with enhancing customer relationships, the bank has developed a feature, partially powered by BDAC, named Personal Finance Manager (PFM). This tool assists clients in effectively managing their personal finances.

The changes identified have led to multiple benefits that directly support two core business objectives: improving financial performance and increasing customer satisfaction and retention. For financial performance, the benefits include significant campaign cost reductions, as well as increased campaign effectiveness. The Everyday Director highlights:

> *"Three years ago, my budget for credit card campaigns was in the order of several million euros per year. Currently, it's in the hundreds of thousands of euros and that's perfectly sufficient for me. Before hyper-personalization, when I conducted campaigns, I would do the same campaign for everyone. Now, being able to identify who the fringes are, those who would contract by themselves, and being able to personalize the offer in line with what the customer likes most, I can*

achieve more impact in terms of sales with a budget that is 20% of what it was three years ago".

Additionally, a reduction in staff costs, even among technical staff working with BDAC, has been identified as a benefit. As the Everyday Director notes:

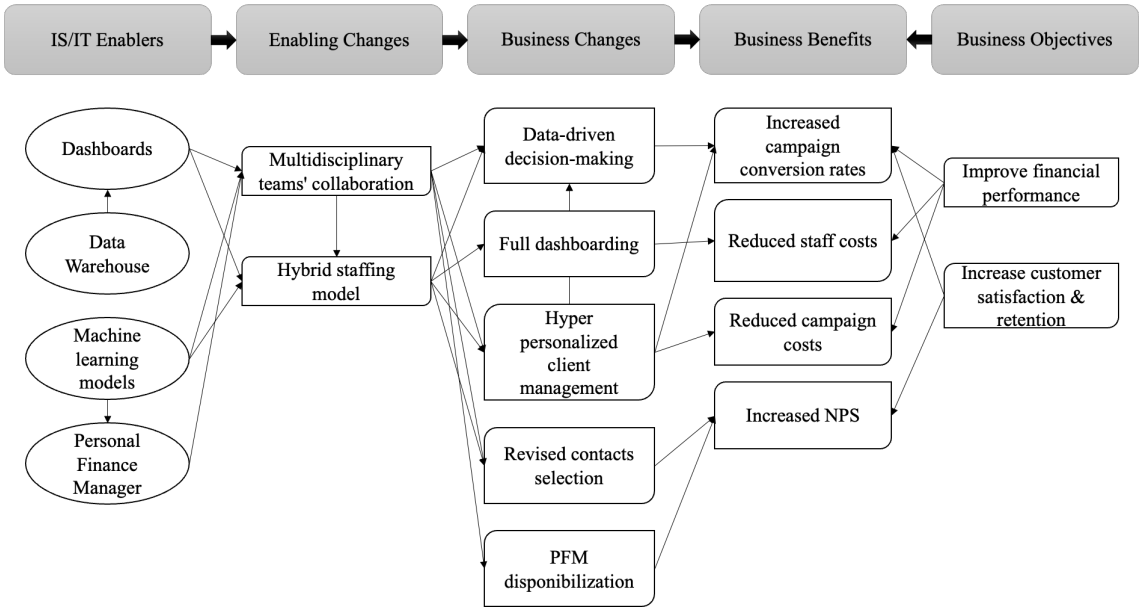
"For my entire business area, I have these two people I mentioned, but there used to be six".

And complements:

"Today, it's possible to do much more with fewer people".

Regarding the objective of increasing customer satisfaction and retention, benefits are seen in the increase of campaign conversion rate and also in the significant improvement in NPS, as the Everyday Director clearly states, "Right now, we are significantly increasing our NPS". Figure 18 represents the benefit dependency network of this segment.

Figure 18 –Benefit Dependency Network of Everyday Banking



Focusing on the savings and investments segment, this study reveals similar IS/IT support mechanisms as found in other banking operations. The segment uses dashboards built over the corporate data warehouse that were developed together with the central technical team with the correspondent technical skills. Additionally, advanced analytics models were implemented through collaboration with the advanced analytics team. Notably, this segment contributes with business knowledge and priority management to these collaborations but, unlike the everyday banking segment, does not involve its own staff in direct development due to lack of budget to have staff with proper skills. Moreover, some developed models were integrated into operational support systems, enhancing functionalities accessible by trained users.

Operational support system users gained access to an enhanced lead management module, significantly supported by the output of machine learning models. Which allows both more effectiveness in sales efforts and the reduction of sales costs. Also related with the usage of advanced models, and particularly relevant for investment offerings, a data informed client analysis has contributed to the insurance of adherence to the Markets in Financial Instruments Directive (MiFID). The Investment Director emphasized, "Investment products, unique to any business, must comply with the MiFID framework. This necessitates a thorough understanding of the customer, as only suitable products can be marketed, requiring vigilant monitoring for deviations from the targeted market."

Additionally, decision-making processes have become increasingly data-driven. This is evident from the implementation of dashboards providing comprehensive sales data and advanced analytics, including propensity models. The Investment Director highlighted:

> *"These tools not only enhance analysis accuracy but also aid in identifying and addressing undesirable patterns".*

For instance, upon detecting redemptions concentrated on a specific product, the Investment Director can initiate targeted interventions:

> *"This enables managers to clarify misconceptions to clients, either in-person or via direct emails, thus managing undue product outflows".*

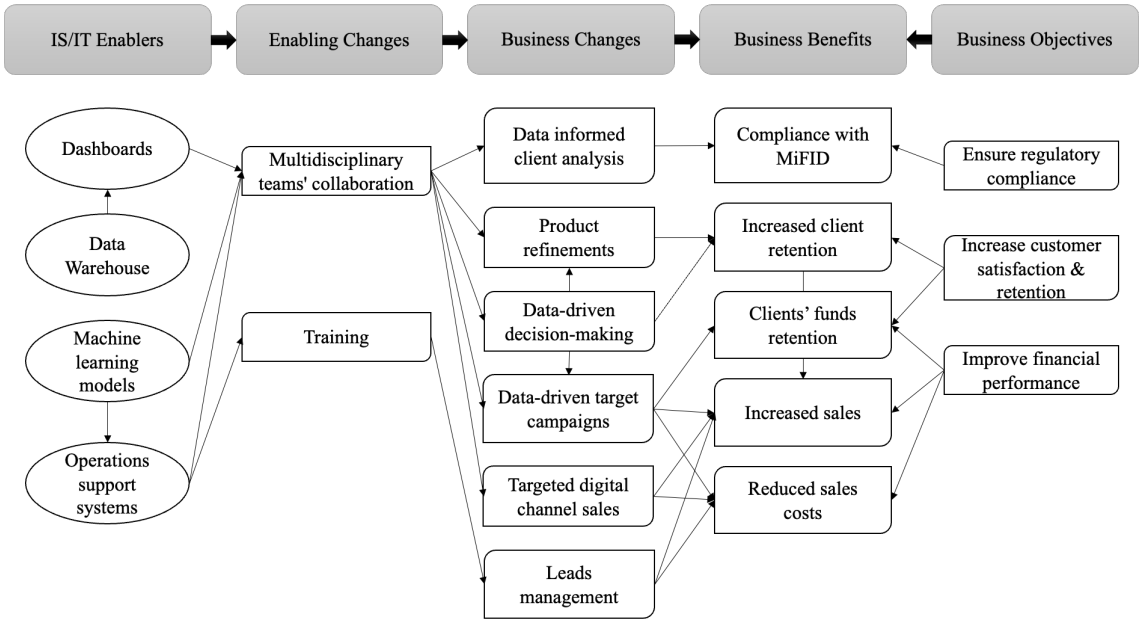
Moreover, the approach to marketing campaigns has evolved, now leveraging data-driven strategies for enhanced targeting. An example is the retention-focused campaigns in savings, where models identify customers with a higher likelihood of departure, allowing for tailored offers. Digital channel sales have also been refined through BDAC, targeting products to clients with a high interest probability. Furthermore, product refinement is now informed by analytical insights, demonstrating the impact of data-driven decision-making also in supporting product management.

The bank has achieved various business benefits from its implemented changes, aligning with the three primary business objectives. The first objective which is improving financial performance, was supported by the increased client funds retention, the increase in sales resulting from data-driven campaigns, and sales cost reductions due to digital channel enhancements and improved lead management. The Investment Director's statement underscores this:

> *"From the moment I can trigger data for automatic contacts to targets that are much more likely, it will increase the overall effectiveness of the sales process, regardless of the channel, but especially enhance much cheaper sales, a much lower cost to serve".*

The second objective, increasing customer satisfaction and retention, is supported by the effect of a better alignment of offerings with client profiles and better targeted campaigns that leverage on the referred better fitting. Lastly, ensuring regulatory compliance, particularly with MiFID, is also a business objective addressed in this context. The benefit dependency network of this segment is illustrated in Figure 19.

Figure 19 –Benefit Dependency Network of Savings and Investments Banking



In the commercial segment, the IS/IT enablers' setup is very similar to other studied segments. Technologically, BDAC serving this segment are twofold. Firstly, dashboards are developed collaboratively with a BI technical area, incorporating business acumen and priorities from this segment. Secondly, ongoing development of specific machine learning models in collaboration with the advanced analytics area leads to several business changes that we will further explore. The segment lacks technical staff for internal solution development, as highlighted by the Commercial Director:

> *"One of the challenges is that I have a huge dependency on these areas for data extraction. We need to evolve to a data lake where they can deposit data, and where I, with more user knowledge than a programmer or data analyst, can use and utilize these data as a service. With more flexibility, faster access, more autonomy, and also more real-time data".*

This quote not only reflects a desire for internal capabilities to enhance data utilization and autonomy, but also that the solutions identified were develop following a collaboration model to which the segment did not contribute with technical staff but only business acumen.

Exploring the business transformations enabled by BDAC, the bank has adopted data-driven strategies for targeting offerings and optimizing client engagement. As the Commercial Director highlights, this shift in data analytics has had a relevant impact in customer relations:

> *"This area of data analytics has completely changed the paradigm of customer relations. Before, due to a lack of information, branches would ask everyone if they wanted the product. And now, I am able to make localized, targeted proposals based on propensity models and next best offer".*

Additionally, the increased volume and insights from client data have informed product design and pricing strategies. The Commercial Director notes the enhanced ability to adjust prices based on customer sensitivity:

> *"With this analytical capability, we can also maximize the price of certain products because some customers are more price-sensitive than others".*

Operational improvements are also evident, such as the strategic deployment of self-banking machines and changes in branch operations, driven by customer transaction data. The Director illustrates:

> *"To give a concrete and very recent example, we now have information about the number of cash transactions made at each branch. We made a change in the transactionality models, therefore, in cash, in about 150 branches based on analytical data from our customers. And we invested in self-banking machines that accept deposits and in 24-hour machines in places where we had less transactionality and it did not compensate to have a person full-time with cash, for example".*

Lastly, client categorization has evolved, with a new focus on 'digitality' levels, influencing how clients are managed and served. Specifically, if a client has a high level of digitality he is now assigned a client manager that operates remotely.

The enhancement in offer targeting and the new client classification based on digitality have positively impacted customer satisfaction. The Commercial Director highlighted the effectiveness of these changes, using the NPS as a metric:

> *"We always monitor whenever there's a change in the service model. We track the starting point and how the customer NPS evolves. It's interesting because there's initially a negative reaction from customers since nobody likes changing the service model, but then it rebounds and surpasses the initial baseline after two months".*

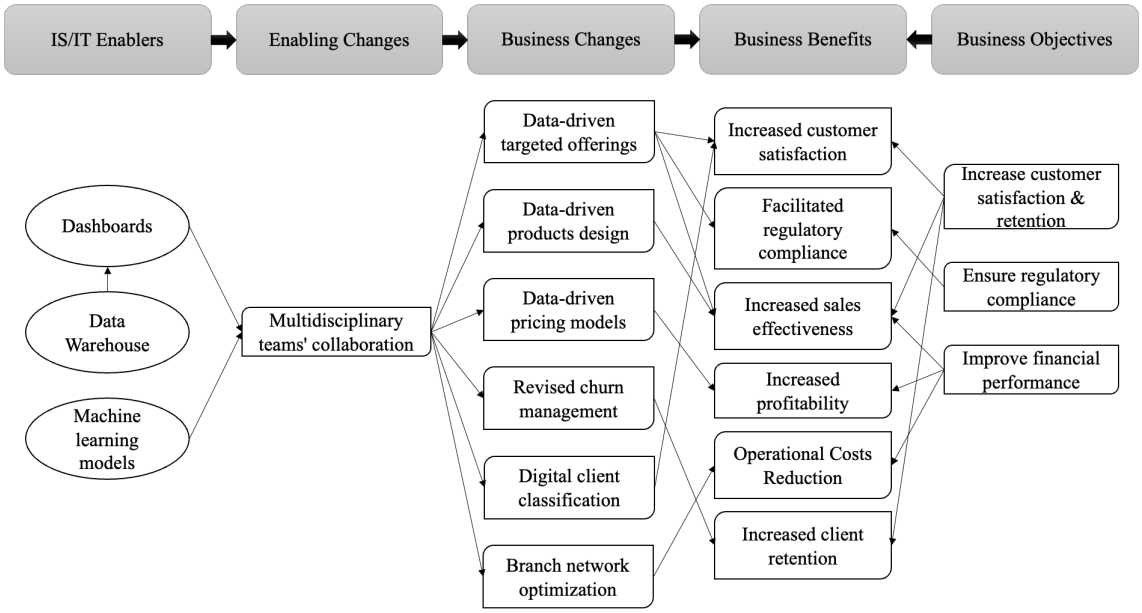
Furthermore, refinements in product targeting and design, as well a revised pricing management, have increased sales effectiveness, product profitability, and regulatory compliance. The Commercial Director exemplifies how this approach supports the compliance with regulations:

> *"To give a concrete example, with deposits, I would not offer a highly complex or risky deposit to a customer with low financial literacy, or who does not comply with the legislation for the protection of these more complex products".*

Increased client retention enabled by the revised churn management, and reductions of operational costs facilitated by an increase of insights that have been supporting rearrangements of the branches network are also benefits identified as resulting from BDAC.

These benefits, represented in Figure 20, directly support the bank's primary business goals of increasing customer satisfaction and retention, ensuring regulatory compliance, and improving financial performance.

Figure 20 –Benefit Dependency Network of Commercial Operations



Future Plans

The future evolution of BDAC at the bank encompasses diverse dimensions. Technologically, a key focus is the ongoing migration to a cloud environment, accompanied by an upskilling plan to enable staff to operate effectively in this new setting. The CRM Director remarked on this development, noting the importance of ensuring the staff is prepared to take advantage of cloud-based tools:

> *"There is now some upskilling happening for tools that work directly in the cloud, as we are undergoing a migration to the cloud. They are also adapting to this change".*

Additionally, the increase in operational models has led to the need to increase automation to manage resources more efficiently, as was also highlighted by the CRM Director:

> *"The issue often arises when we start to have a very large backlog of implemented models, as the maintenance of these models begins to take up an increasingly larger portion of resources, leaving less for new developments. Therefore, there is a process of automation and efficiency in these continuous improvements".*

This automation aims to free up capacity for addressing new developments.

The Analytics Director revealed an interest in exploring generative AI, indicating a proactive approach to keeping up with scientific advancement done by the analytics team:

> *"The organization doesn't know that we are reading articles about generative models. We do it because people like to read and because they like to continue evolving, they like to do science, therefore".*

This forward-looking perspective shows how the bank seeks to continuous evolve its BDAC.

In the context of business activities, future evolutions of BDAC are anticipated. The Investments Director emphasizes the aim for improved dashboard organization:

> *"My plan is, as much as possible, to try to organize information in dashboards that are already made with strictly necessary information, as I see that there is certain information that assumes a certain importance for various reasons, and that's the direction I'm going in. In essence, it's about systematizing".*

Concurrently, the Commercial Director highlights a plan for enhanced data integration, facilitating new insights, particularly in measuring business performance:

> *"We have plans for greater integration of data that are already produced in applications we have here, both for the use of commercial areas and for performance measurement".*

The bank's future BDAC evolution aims to deepen client understanding and increase the level of customization. The CRM Director discussed developing 'next best interaction' models, a progression from the current 'next best offer' models, with an emphasis on real-time responsiveness:

> *"If I can start to understand that a customer who clicked on this button went there, did that, it makes sense to change to next best offer because of something. This*

> *implies that the model itself may have a real-time or near real-time reaction. This involves, in some cases, retraining models, but also exploring these digital information data that are not yet so explored to first understand this behaviour. One of these themes is evolving from next best offer to a kind of next best interaction, but more in real-time, that is the personalization component we want to evolve".*

Natural language processing is being explored to improve operational processes, as the CRM Director explained:

> *"Then we have components related to natural language; we are already doing some exercises, for example, interpreting emails that arrive for distribution and having greater agility in the distribution of such things, but we are not yet working with voice, for example. This theme can then connect with an improvement of chatbots, for example, which are still a bit simple. The voice IVRs themselves that contact center teams and telephone service lines use can also take more advantage of this, and then the additional ranges that come with it, it's not just about distribution, but it's the tone of voice with a customer that sentiment analysis can provide. Can I then connect this to the operator to understand that they are speaking with an upset customer? These ranges, in essence, are dimensions that we have not yet explored".*

These initiatives show there is a belief that there is still room for reaching benefits through the usage of advanced analytics technology that is not yet explored.

Discussion

The bank's BDAC strategy incorporates both traditional analytics and innovative approaches, particularly through the Advanced Analytics team. As mentioned by the CRM Director responsible for creating this team, this team's mission is to innovate and challenge existing practices:

> *"These teams have a bit of this mission, which is to create a bit of a vanguard challenge by doing different things".*

So, the advanced analytics team was created with the expectation of playing a relevant role in fostering innovation, as well in competitive advantage creation as we will further explore. The CRM Director also notes the widespread yet unrecognized use of advanced technologies within the organization:

> *"What is interesting is that they are very widespread in the organization, I think that sometimes the organization is using and does not know that it is using advanced technologies".*

Additionally, the Analytics Director points out the team's approach to implementing new technologies:

> *"What we usually do, and it's a policy of the organization that I fully subscribe to, is a proof of concept to prove that it works and then scale up".*

This can be argued to be a way of supporting the adoption of these relatively new technologies, as we have also seen in the Telco case study.

The pursued innovative impact of advanced analytics can be seen in several implemented changes within the bank. One relevant example was shared by the CRM Director:

> *"It was at the time when Netflix made their code open source. This led to the innovation of a different model from what, for example, the other units are doing, which are using a more traditional model. And within the confidentiality protection we have here, one result that I think is spectacular from this type of model is that we look back to understand what our NBO model is getting right. In the last 12 months, in moving windows, 80% of customers bought products from the top 3 positions of the NBO, which means there is a very interesting level of accuracy for this type of activity".*

This illustrates how this team laying on an opensource model developed their own version to achieve improved sales effectiveness. Furthermore, one humanitarian effort occurred during the pandemic was also shared by the same Director:

> *"The Bank created a project for elderly people. They called it 'here and now,' which involved managers calling clients identified as potentially vulnerable and isolated at home, to ask if they needed anything. It was strictly forbidden to talk about products; it was more about asking, 'are you okay, do you need anything?' This was for people who they knew usually went to the branch, asked for assistance, and similar things".*

This initiative, initially focused on social support, later became instrumental in developing a sentiment analysis model, demonstrating how this team seeks for opportunities to explore new technologies. This seek of explorative approaches, as we had already seen in the usage of proofs of concept, is a dominant theme under the scope of advanced analytics.

Innovation can also be seen in simpler technical scenarios usually addressed by the bank's business intelligence area. The unique 'crops' approach in client segmentation stands out, where clients are grouped following a very specific rational, and decisions are tailored within this context. Additionally, the bank's shift to assign a 'digitality' level to each client based on past interactions marks a significant change. This not only reduced costs but also enhanced the NPS for affected clients. These changes demonstrate the bank's commitment to leveraging BDAC in transformative ways, aligning with the Investment Director's perspective:

> *"In recent years, there is an increasingly prevalent culture of exhaustively grounding everything that is done in the light of data, of more concrete analyses".*

Although the increased need for data to support decisions can be argued to pose a threat for delaying decision-making, the examples data collected is not clear in that regard.

In prior case studies the absence of robust data governance is perceived as an impediment in fully leveraging the potential of BDAC. Still, in this case where data governance is in place its existence seems to be perceived as a challenge. This perspective is notably echoed by both the Everyday Director and the Analytics Director. The Everyday Director, while addressing the challenges encountered, emphasizes data governance responsibilities:

> *"Then we have the issues of what we call data ownership. We, the business areas, have ownership of business data, and therefore we must ensure their consistency. For this reason, every month we need to conduct some tests to validate that the data being produced is accurate".*

This comment focus the question of whether business activities are effectively synchronized with the demands of prevailing data governance protocols, especially when they are directly engaged as in this case. Moreover, the Analytics Director shares the limitations imposed by the bank's policies on data exploration:

> *"Obviously, from an analytical perspective, this is regrettable. If we were operating in the United States, it would be much more interesting because this handicap does not exist".*

Hence, data governance, while serving as a compliance safeguard, concurrently acts as a constraint on exploring some analytical possibilities.

The participants in this research emphasised BDAC's role as means to reach competitive advantage. The strategy followed to establish an in-house advanced analytics team is a good example of such belief. The CRM Director noted:

> *"Our strategy also involved a choice: we could have sped up the process significantly through external subcontracting, for example, by purchasing services. However, the issue was that we believed this should be a competitive advantage. It's unthinkable that a company like Google would outsource advanced analytics".*

Applying the VRIO framework for the analysis: Value can be seen in unique client data, which enabled several personalization efforts; Rarity is being assured by unique, internally developed solutions; Imitability is sustained due to in-house development and early investment in advanced analytics solutions; Organizationally, the formation of an advanced analytics team working closely with business segments, as well as an hybrid model that ensures effective analytics development can be argued to ensure an effective organization to ensure BDAC are proper capitalized. Hence, the overall data strategy and how data democratization is being assured can be seen as playing a key role in ensuring competitive advantages.

While collaboration between technical and business areas was mentioned as being essential in the bank, there's a growing desire for greater autonomy, especially in data access and analysis. The Commercial Director highlights this, emphasizing a dependency on technical areas for data extraction and the need for a more accessible and user-friendly data lake:

> *"I am highly dependent on these areas for data extraction. We need to evolve towards a data lake where they can deposit data, and where I can use these data as a service, with a user's knowledge rather than that of a programmer or data analyst, right? With more flexibility, quicker access, more autonomy, and also more real-time data".*

This desire for autonomy can be the result of an increased pressure to base decisions on data as was also mentioned by the same director:

> *"And this is a trend that I feel - the more analysis we do, the more data we need. It's almost a vicious cycle. Sometimes when we want more and more data, we face the risk of not making decisions and always searching for the data that gives us 100% certainty".*

Unlike the Commercial Director, the Everyday Director, operating in a hybrid model with direct staff involvement, does not express a need for more technical staff, which

suggests the hybrid approach might be more effective in managing the growing demand for data-driven decisions.

The establishment of an advanced analytics area in the bank, as described by the CRM Director, has fostered a data-driven, creative, and innovative organizational culture:

> *"I believe there is a contagious effect in which the entire organization becomes more data-driven, more creative, and more innovative".*

This transformation extends beyond traditional analytics, with the 'pods' model enhancing collaboration and also commitment across business segments. Notably the strategies for advanced analytics and traditional analytics differ: the former targets specific needs with custom solutions, while the latter focuses on decision-making and future reusability, as evidenced by the full dashboarding policy. Therefore, the bank's BDAC strategies vary in function to the technological approach best suited for different needs. Worth noting the advanced analytics solutions tend to more exploratory and subject to proofs of concepts, while traditional analytics are more straight forward.

Conclusions

This case study examines a banking institution, still the overarching business objectives supported by BDAC align with the ones observed in other companies from different industries. So, it is not surprising that the benefits here identified are in general very similar to those identified in the other studied industries. Changes that seek operational efficiencies and sales increase sustain the objective of improving financial performance. BDAC also sustains changes that contribute to achieving regulatory compliance by enabling a nuanced understanding of client profiles, fostering a safer regulatory engagement. Moreover, a central theme of customization emerges, pivotal for improving financial performance but also for improving customer satisfaction and retention. This trend towards customization is prominent in both commercial and operational activities, which can be a reflection of the bank's shift to digital channels.

In the evolving context of banking, direct client interactions are increasingly supplanted by digital platforms which tend to be the focus. In the bank under study BDAC are used to enhance personalized customer experiences despite reduced face-to-face engagement. Not only clients that are being pulled to a more digital-based relationship are being categorized as being more prone to that change by BDAC. But also, the bank's BDAC-driven initiatives are elevating the personalization in customer engagement, with plans for improvements as is the case of the development of next best interaction models. This strategic use of BDAC can be argued to be sustaining a shift to digital interaction models without losing the personal touch in customer service. Although it can be soon to understand the impacts a move of this nature can have, even more so when it is an ongoing change, the results of the NPS indicator calculated over clients served on digital have been positive.

In examining the pivotal question of this study, "How do firms benefit from big data analytics capabilities?", this firm's case adds valuable insights. Broadly, business benefits align with efficiency and effectiveness, consistent with other firms and literature. However, the specifics of this case contribute to achieving a more nuanced understanding on how these benefits are achieved. In the context of advanced analytics, all studied business segments have a similar approach collaborating through sharing business needs and understanding. This collaborative approach, as in the other cases, seem to be effective as there are several successful initiatives that resulted from it.

The bank's BDAC organization related with traditional analytics, particularly its 'pods' model, stands out for effectively meeting activity-specific needs. This structure appears to optimize alignment with business priorities, especially where mixed staffing is present. In contrast, segments relying solely on central technical teams express frustration due to dependency. Worth noting these needs revolve around a pull for democratized data access that was seen in some segments of this firm, but also in other studied firms.

Chapter V – Data Analysis

The empirical foundations of this research are anchored in four case studies, each representative of different industrial sectors. This chapter presents a cross-analysis of these case studies, employing a cross-case synthesis approach as advocated by Yin (2018). Also, the thematical analysis, that supported the previous chapter, supports this cross-case analysis. Central to the analysis is the adoption of the benefits management framework, aligning with the work of Ward & Daniel (2012). This approach facilitates a structured analysis of the case studies, also providing a foundation that facilitates the communication of the analysis.

Moreover, this chapter aims to achieve theoretical integration. It seeks to confront the empirical findings with theoretical constructs, ensuring a cohesive narrative that bridges practical insights with academic theoretical backing. This integration is pivotal in contextualizing the empirical data within the broader landscape of academic theorical body of knowledge, thereby enriching the depth and scope of the study's contributions.

This synthesis of theory and practice serves a dual purpose: firstly, to extrapolate and analyse the key benefits as observed across the various case studies, and secondly, to critically evaluate these benefits following the logic of the benefit dependency network of Ward & Daniel's (2012) model. The emphasis is on drawing comparisons and contrasts, shedding light on how different industries leverage and realize benefits in distinct yet interconnected ways.

5.1 IS/IT Enablers

The individual analysis of each case study has highlighted a range of IS/IT enablers employed by the four companies under analysis (Table 13). Among these, certain technical components, inherently analytical in nature, were anticipated. This includes the utilization of dashboards, data warehouses, data marts, and data lakes. Moreover, also solutions that fall within the scope of Advanced Analytics were found. These technological enablers are a common theme across all the studied companies. However, it is noteworthy that the components related to Advanced Analytics exhibited distinct specificities unique to each case, reflecting the tailored application of these tools in different organizational contexts.

In addition to fundamentally analytical solutions, this research also identified other IS/IT components serving as enablers within the scope of BDAC. These solutions broadly fall into two categories: specialized data-driven custom applications and operational systems. The data-driven applications are heavily reliant on analytical features, aiming to provide data-centric features, although they exhibit features that go beyond the scope of BDAC. On the other hand, operational systems in this context primarily function as data sources for these analytical solutions. While some operational systems do incorporate analytical features, their impact is noticeably less pronounced compared to that of the core data-driven solutions.

While operational systems emerged as key data sources across all studied companies, data sources go beyond internal systems in most cases. Notably, in three out of the four companies analysed, there was evidence of usage of external data sources. The absence of such evidence in one company could either indicate a non-reliance on external sources or that the access provided to this study did not allow such identification. The adoption of varied data sources aligns well with the 'Variety' aspect of big data (George et al., 2016). Additionally, the study's findings resonate with other dimensions of big data classification. Notably, the aspects of 'Volume' and 'Velocity' are also evident in these cases (George et al., 2016). Moreover, the principles of 'Veracity' (Demchenko et al.,

2013) and 'Value' (Wamba et al., 2015) are prevalent. Further dimensions, including 'Variability' and 'Visualization' (Seddon & Currie, 2017) also manifest within the contexts of these companies. As will now be developed.

Table 13. IS/IT Enablers Identified in the Cases

Case	IS/IT Enablers
Telco	Dashboards Data Warehouse (Corporate and Segment) Data Marts Data Lake Advanced Analytics Models (e.g., Churn Model) Specific Data-driven custom solutions • Gamification Platform • Customer Data Platform Operational Systems External Data Sources
Logistics	Dashboards Data Warehouse Data Lake Data Marts Advanced Analytics Models (e.g., Route Optimization) Specific data-driven custom solutions • Revenue Assurance Operational Systems External Data Sources
Insurance	Dashboards Data Warehouse Operational Systems Advanced Analytics Models (e.g., NLP, experience, NBO) Specific data-driven custom solutions • Document processing Operational Systems External Data Sources
Bank	Dashboards Data Warehouse Operational Systems Advanced Analytics Models (e.g., NBO, personalization) Specific data-driven custom solutions • Personal Finance Manager Operational Systems

All organizations examined in this study are prominent entities within their respective industries, serving substantial client bases. This scale naturally gives rise to

high volumes of data, a characteristic that was consistently observed across all cases. Client data emerged as a pivotal element in every studied segment. However, it was noted that data sourcing strategies invariably extended beyond mere client information. Commonly, additional data sources, such as operational and sales data, were employed to augment and enrich the client data. Also, external data sources are used to enrich client information as is specially clear in the Logistics case. Furthermore, the aspect of 'Velocity' in data handling was identified as a focal point for investment. In each organization, there have been recent technological advancements leading to near real-time or even real-time data processing capabilities. This observation was corroborated by various study participants who acknowledged an increased demand for faster data processing, demand that at least in part has been fulfilled in several cases. A notable trend observed was the correlation between cloud adoption and heightened expectations regarding data velocity, which could indicate a shift towards more agile and responsive data handling architectures supported by cloud environments.

Regarding 'Veracity,' indications suggest it is an area of concern, although primarily outside the direct scope of this study due to access limitations. Nonetheless, initiatives geared towards data quality to foster trust were observed. A notable example is the approach taken by an insurance company, where data consolidation is perceived as a critical measure to ensure data quality. This was mentioned by their IS/IT Director:

> *"Our main focus at this moment, in terms of information quality, is on a very specific area, which is the consolidation of information from our multiple operations."*

Additionally, the 'Value' derived from data was evidently recognized across the cases. This is further accentuated by the prevailing belief that big data-based solutions are instrumental in cultivating competitive advantages because that enable accessing data' inherent value. This linkage with competitive advantages will be explored in greater depth in a subsequent section of this chapter.

During the course of this study, 'Variability' was a notable observation, primarily due to the need for different interpretations of the same data sources across various segments, each with distinct objectives. Moreover, the frequent integration of new data sources within these organizations also supports the presence of variability, reflecting a dynamic data environment. Additionally, 'Visualization' emerged in this study as a prominent theme. Each segment of the organizations studied possessed specialized capabilities tailored to data visualization. However, it was observed that the approaches to ensuring visualization capabilities varied significantly from an organizational perspective, a point that will be delved into more deeply in the forthcoming sections of this analysis.

In cross analysing the cases, it becomes evident that despite operating in diverse industries, the companies studied exhibit reliance on similar IS/IT enablers. Common across all these organizations is the presence of analytical solutions, encompassing both traditional and advanced approaches. Each company integrates data-driven features within their systems, utilizing internal systems as primary data sources, often extended with BDAC related functionalities. As this analysis progressed, it became clear that traditional and advanced analytical capabilities often fulfil distinct roles. Traditional analytics is typically oriented towards facilitating decision-making processes, while advanced analytics is often used to address highly specific organizational needs. It is important to clarify at this point that within the context of this study, 'advanced analytics' refers specifically to the employment of machine learning models or comparable technologies. This distinction forms a crucial aspect of our exploration and will be elaborated upon further in this chapter.

5.2 Enabling Changes

A critical aspect of understanding how the firms in this study leveraged BDAC for achieving benefits lies in analysing the key changes they implemented. These changes, as outlined by Ward & Daniel (2012), should be divided into two distinct types: some are one-off transformations, while others involve ongoing modifications in daily operational practices. This section of the document focuses on the former, with the subsequent section

addressing the latter. Table 14 in the document shows the enabling changes identified through this research. A predominant enabler emerging from the study is the collaboration within multidisciplinary teams. According to the participants, these collaborations are crucial across various business activities and firms, albeit manifesting in different forms depending on the specific organizational context and industry sector.

Table 14. Enabling Changes Identified in the Cases

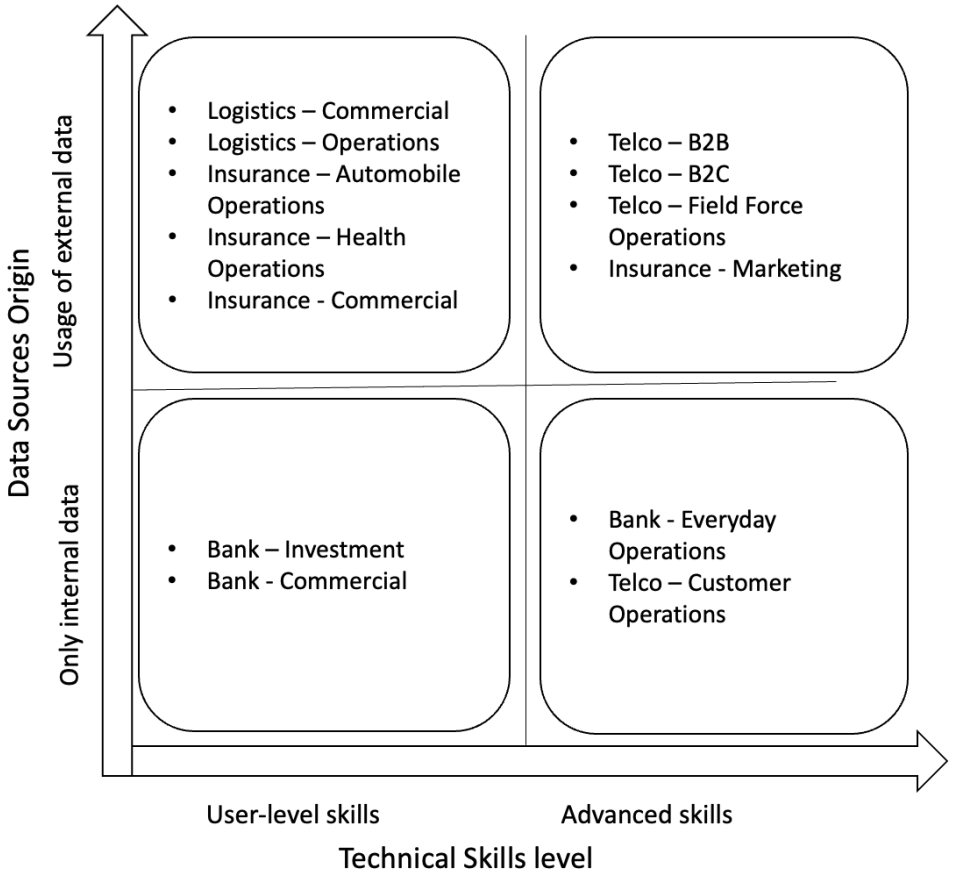
Case	Enabling Changes
Telco	Multidisciplinary teams' collaboration Training (segments staff upskilling) Data quality assurance Internal divulgation of changes
Logistics	Multidisciplinary teams' collaboration OKR's introduction Data quality assurance Organizational reorganization (technical data teams)
Insurance	Multidisciplinary teams' collaboration Training (segments staff upskilling) Data quality assurance External divulgation of changes
Bank	Multidisciplinary teams' collaboration Organizational reorganization (hybrid)

A crucial element in understanding the nature of the collaborations required from a business segment perspective lays on whether the segment possesses staff with technical analytical skills. The studied segments displayed a diverse range of competencies. All segments demonstrated business skills as would be expected, which are crucial for steering the development of solutions and aligning them with business objectives. Still, lacked the capacity for independent technical development of these solutions. On top of business acumen, most of the studied business activities were found to show analytics user-level skills, enabling staff to develop basic analytical solutions, typically in the form of dashboards. Notably, this research also discovered business activities where staff had more advanced technical skills, granting them greater autonomy in solution creation and implementation. The collaborative approaches seen in the segments laid on data access, indicative of a trend towards data democratization. However, data democratization, as

defined in literature (e.g., Samarasinghe & Lokuge, 2022), implies access to data without the necessity for specialized skills, a condition not universally met in the observed organizations. This discrepancy can be argued to indicate efforts of the different business activities to effectively capacity themselves to better take advantage of the data made available to the segments. Which creates the need for greater technical capacitation at activity level.

The analysis identified a segments' trend towards seeking an increase in autonomy regarding BDAC. In pursuit of this autonomy, has we have seen, some segments have established technical teams endowed with skills surpassing basic user-level capabilities. Although, despite the advanced technical acumen within these teams, collaboration remained a crucial element, both intra-activity and inter-activity, as there were always identified dependencies as we will further explore. Furthermore, the democratized data access can be seen under the leans of systems theory, suggesting that external data sources can support organizations in more effectively adapting and responding to their external environment (Knyazeva, 2020). Figure 21 illustrates how the different segments included in this study integrate varying levels of technical skills with the utilization of external data sources, providing a visual representation of their strategic approaches to the data they have access.

Figure 21 – Technical Skills and Data Origin Dimensions in the Cases



An important observation from the study is that segments lacking advanced technical skills exhibited a greater dependence on central IT teams. In such scenarios, the collaboration dynamic shifted, with the business segment assuming only the role of an internal client. This is particularly evident in the banking industry company studied, where segments with only user-level skills and exclusive reliance on internal data were identified. This approach appears to be influenced by the data protection regulations which restrict the use of external data sources. Consequently, all the bank's studied activities were found to be non-users of external data. Notably, one of the business activities identified as possessing advanced skills while using only internal data was the bank's everyday operations. While data protection policies partially account for this limited external data usage, the advanced skills in this business activity emerge from a hybrid model. The nuances of this model, due to its unique characteristics, warrant a

deeper exploration in a separate section of this chapter. Furthermore, also Customer Operations from the Telco case was identified as possessing advanced skills and using only internal data.

In the quadrant encompassing segments with user-level skills and the use of external data, we find both segments studied from the logistics company, and all the studied segments of the insurance company at the exception of marketing. The logistics company's segments, as observed, were staffed with individuals whose skills in the context of BDAC did not surpass the user-level. However, the shared plans to enhance these skills suggest a recognition of this as a current limitation. Regarding external data, notable examples include the commercial segments utilizing purchased data to refine client information and operations segments directly integrating data that enables route optimization, which includes traffic information. Furthermore, the three studied business activities from the insurance company also fall into this quadrant. These segments utilize external data, such as information related with, current or potential, service providers, to support decision-making processes. While these segments do have staff with analytical skills, they largely depend on the collaboration with IS/IT and Advanced Analytics departments for developing solutions that allowed the benefits this study identified. An exception is observed in the production of decision-support dashboards. Even though these are based on platforms provided by IS/IT, the segments demonstrate a degree of autonomy in conducting their targeted analyses, which strengthens the identification of user-level skills.

In the quadrant where advanced technical skills intersect with the use of external data, we identified all of Telco company's segments, except for Customer Operations, as well as the marketing segment of the Insurance company. These segments are characterized by their teams' high level of technical autonomy. Interestingly, this autonomy does not eliminate the need for collaboration with other teams and activities, a dynamic that will be elaborated upon later in this chapter. The utilization of external data in the segments related with marketing were expected due to the usage of market studies, which are a typical form of external data under the context of that function. In the case of

the Telco company's Field Force Operations, an illustrative example of external data usage is weather information, which was identified as playing a crucial role in supporting planning activities.

In addition to collaboration and its relationship with skill levels within various segments, other key enablers were identified. Training investments were identified on both the Telco and Insurance companies, aiming for the enhancement of their teams' capabilities through targeted training programs. This approach was also identified in future plans shared by the commercial segments of the Logistics company. These training initiatives were found to be specifically tailored to develop technical skills that align with the technologies employed in these organizations. For instance, in the Insurance company, where SAS is a primary tool, training efforts were focused on this platform. As shared by the Marketing Manager of the Insurance company:

> *"They have been making some upgrades over time in their training and have undertaken training in SAS".*

Data quality emerged as a recurring theme in the analysis, serving as a crucial enabler across the studied companies. Interestingly, this focus on data quality was not identified in the banking company, suggesting a lack of concern or awareness among the participants regarding such initiatives, or an unlikely lack on need of efforts in this regard. In companies where the emphasis on data quality was evident, the approaches varied, partly due to differences in team organization. In the Logistics company, a more centralized model places data quality as a primary concern of the Data Office. The Data Office Manager highlighted this focus while discussing operational challenges:

> *"Some of data quality, especially from the more operational sources, more real time or near real time. We have some needs for corrections".*

Contrastingly, both the Telco and Insurance companies were found to encounter data quality challenges at multiple levels, including centralized and decentralized teams. This phenomenon could be attributed to their more decentralized organizational models. Still,

in the Insurance company, the IS/IT area views centralization as a strategic approach to enhance data quality. The IS/IT Director's observation reflects this perspective:

> *"The quality of information is a relevant and pertinent issue, our main focus at this moment, in terms of information quality, is on a very specific domain, which is the consolidation of information from our multiple operations".*

In addition to the previously discussed enablers, organizational changes emerged as a significant theme and will be given dedicated attention in a specific section of this chapter. Other changes include communication initiatives, both internal and external, that were identified as crucial in raising awareness of new features and capabilities under the scope of BDAC. Finally, in the Logistics company, the top management's decision to implement OKRs played a pivotal role in fostering the adoption and development of BDAC as examined in the company's case study, highlighting how organizational restructuring can serve as a powerful catalyst for the effective utilization of BDAC.

5.3 Business Process Changes

The analysis of each case study within this research has identified several business process changes implemented in the four cases. These changes are systematically identified in Table 15. To aid in the cross-case analysis, the table also categorizes these changes into broader classifications. These categorizations have been derived from recurring themes observed throughout this research. The identified categories are as follows:

- Decision-Making: Includes changes such as "Data-driven decision-making", "Data-informed budget management", and "Data-driven pricing models". These changes are linked with strategic and financial decision-making processes by leveraging data analytics for informed choices and planning.
- Customer Relationship Management: Encompassing changes such as "Data-informed churn management", "Data-informed customer relationship

management", "Data-driven up-sell & cross-sell campaigns", and "Personalized client communication". These changes focus on improving customer interactions, understanding behaviour, and increasing satisfaction and loyalty through data-informed insights.

- Human Resources Management: Changes like "Revised incentives model" and "4 days working model" are included in this category that includes shifts in employee engagement strategies and workplace policies aimed at enhancing performance and satisfaction.
- Sales & Marketing: Including changes such as "Data-driven campaigns design", "Data-driven commercial performance management", and "Data-driven targeted campaigns". These changes are aimed at optimizing sales and marketing strategies through data-driven insights to increase revenue and market presence.
- Operational Efficiency: Encompasses a wide array of changes such as "Data-driven continuous improvement", "Revised capacity management", "Data-driven operational management", and "Revised billing process". These changes aim to optimize resource use, improve process efficiency, and enhance overall operational performance.
- Supply Chain Management: Including "Revised information sharing with suppliers" and "Share of tracking information with clients", reflecting enhancements in the flow and management of goods and services, and improved supplier and client relationships through efficient data sharing.

Table 15. Business Process Changes Identified in the Cases

Case	Business Process Changes	Segment	Categorization
Telco	Data-driven P&S Portfolio Management	B2B & B2C	Sales & Marketing
	Data-informed sales	B2B	Customer Relationship Management
	Data-informed churn management	B2B & B2C	Customer Relationship Management
	Revised proposals process	B2B	Sales & Marketing
	Revised incentives model	B2B & Customer Ops	Human Resources Management
	Data-informed customer relationship management	B2C	Customer Relationship Management
	Data-driven up-sell & cross-sell campaigns	B2C	Sales & Marketing
	Data-driven continuous improvement	B2C, Customer & FF Ops	Operational Efficiency
	Support agent allocation criteria change	Customer Ops	Operational Efficiency
	Revised capacity management	Customer & FF Ops	Operational Efficiency
	Revised selfcare channel	Customer Ops	Operational Efficiency
	Data-driven preventive corrective actions	Customer Ops	Operational Efficiency
	New client relationship model	Customer Ops	Customer Relationship Management
	IS/IT changes data-driven impact assessment	FF Ops	Operational Efficiency
	Data-driven scheduling availabilities management	FF Ops	Operational Efficiency
	Revised information sharing with suppliers	FF Ops	Supply Chain Management
	Share of tracking information with clients	FF Ops	Customer Relationship Management
	Data-informed budget management	FF Ops	Decision-Making
	Business Process Changes	**Segment**	**Categorization**
Logistics	Data-driven continuous improvement	Ops	Operational Efficiency
	4 days working model	Ops	Human Resources Management
	Revised billing process	Ops	Operational Efficiency
	Data-driven capacity planning	Ops	Operational Efficiency
	Near real-time decision-making information	Ops	Operational Efficiency
	Increased data to control mandatory service levels	Ops	Operational Efficiency
	Data-informed churn management	Commercial	Customer Relationship Management

	Data-driven campaigns design	Commercial	Sales & Marketing
	Data-driven up-sell & cross-sell campaigns	Commercial	Sales & Marketing
	Data-driven clients' behavior analysis	Commercial	Customer Relationship Management
	Data-driven product management	Commercial	Sales & Marketing
	Data-driven commercial performance management	Commercial	Sales & Marketing
	Business Process Changes	**Segment**	**Categorization**
Insurance	Data-driven continuous improvement	Auto Ops	Operational Efficiency
	Automated expert evaluation scheduling	Auto Ops	Supply Chain Management
	Automation of responses to automobile claims	Auto Ops	Customer Relationship Management
	Full internalization of operation	Auto Ops	Operational Efficiency
	Data-driven operational management	Health Ops	Operational Efficiency
	Data-driven quality control	Health Ops	Operational Efficiency
	Data-driven capacity planning	Health Ops	Operational Efficiency
	Automation of reimbursement and invoices	Health Ops	Customer Relationship Management
	Data-driven sales Management	Commercial	Customer Relationship Management
	Data-driven sales process	Commercial	Sales & Marketing
	Better informed up-sell	Commercial	Sales & Marketing
	Data-driven management of product usage	Commercial	Sales & Marketing
	Improved capacity for decision-making	Marketing	Decision-Making
	Data-driven marketing campaigns	Marketing	Sales & Marketing
	Increased partners access to commercial insights	Marketing	Sales & Marketing
	Better informed product development	Marketing	Sales & Marketing
	Improved customer journeys	Marketing	Customer Relationship Management
	Personalized client communication	Marketing	Customer Relationship Management
	Business Process Changes	**Segment**	**Categorization**
Bank	Data-driven decision-making	Everyday & Investment Ops	Operational Efficiency
	Full dashboarding		Decision-Making
	Hyper personalized client management	Everyday Ops	Customer Relationship Management
	Revised contacts selection	Everyday Ops	Sales & Marketing

PFM availability	Everyday Ops	Customer Relationship Management
Data informed client analysis	Everyday Ops	Customer Relationship Management
Product refinements	Investment Ops	Sales & Marketing
Data-driven targeted campaigns	Investment Ops	Sales & Marketing
Targeted digital channel sales	Investment Ops	Sales & Marketing
Leads management	Investment Ops	Sales & Marketing
Data-driven targeted offerings	Investment Ops	Sales & Marketing
Data-driven products design	Commercial	Sales & Marketing
Data-driven pricing models	Commercial	Sales & Marketing
Revised churn management	Commercial	Customer Relationship Management
Digital client classification	Commercial	Customer Relationship Management
Branch network optimization	Commercial	Operational Efficiency
	Commercial	
Business Process Changes	**Segment**	**Categorization**

The structuring of research collaboration agreements with the participating companies called for involvement of participants from commercial and operational activities. Consequently, it could be anticipated that categories such as “Sales & Marketing”, “Customer Relationship Management”, and “Operational Efficiency” would prominently feature in the business process changes observed. This expectation was indeed reflected across all the studied companies. The involvement of personnel from these specific functional areas naturally created a focus towards business process changes related with sales strategies, customer relationship dynamics, and operational processes.

In examining the "Sales & Marketing" process changes, it became evident that all the studied companies had implemented changes under this scope driven by the possibilities offered by BDAC. The nature and impact of these changes varied. Some were strategic, influencing the definition of commercial offerings, while others were more tactical, aiming targeting clients with data-driven criteria. Also related to commercial activities and observed across all companies, were changes in “Customer Relationship Management”. These modifications predominantly focused on personalization, leveraging BDAC-enabled insights for a deeper understanding of customer needs and behaviours. Processes were changed to support more tailored approaches in client interactions, moving towards personalized experiences at an individual level. Notably, while all firms implemented changes in this area, the Logistics company exhibited fewer modifications in this regard. This could potentially be attributed to a comparatively less significant adoption of advanced analytics capabilities, suggesting a correlation between the extent of analytics capabilities sophistication and the level of client personalization reached.

In the analysis of business process changes, "Operational Efficiency" emerged as a predominant category within the operations segments of the studied companies. This trend aligns with the inherent objectives of these functions, which are typically aimed towards optimizing processes and resources. A particularly relevant theme within this scope was capacity planning, encompassing various operational elements such as support agents, field engineers, and delivery vehicles. It's important to highlight that some

changes, primarily aimed at operational efficiency, also had a profound impact on Human Resources Management. For instance, the optimization of branch networks in the Banking case led to the consolidation of physical branches and subsequent staff reallocations. Similarly, the complete internalization of the Insurance company's operations for automobile insurance claims had significant human resource implications. Additionally, it is observable that most of the identified process changes, while targeting operational efficiency, were closely intertwined with data-driven decision-making. These changes illustrate how BDAC are usually used, i.e., supporting decision making. However, there were exceptions, such as the improved billing process in the Logistics company, where the change was less about data analytics and more about streamlining the billing operation itself although this change was achieved with BDAC. This exception can be argued to be an indicator of how BDAC can be instrumental in process reengineering beyond decision-making, still the data collected by this research is scarce to support such conclusion.

In our analysis, certain categories identified were less prevalent across the cases but held significant implications in specific instances. The introduction of a 4-day working week in the Logistics company, categorized under “Human Resources Management,” stands out. This change is particularly illustrative of the transformative impact BDAC can have on organizational structures. It exemplifies an innovative approach to workforce management, prompted by insights gained through BDAC. Similarly, modifications classified under “Supply Chain Management” demonstrate how BDAC facilitates enhanced interactions with business partners, both upstream and downstream. This suggests BDAC has the capacity to streamline and strengthen supply chain networks, leading to more efficient and collaborative partnerships. Additionally, the practice of full dashboarding in the Banking case, while not as widespread, represents a notable best practice identified in this research. This practice calls for analytical reuse, promoting efficiencies and can be argued to support the development of data-driven decision-making within the organization.

5.4 Business Benefits

The individual analysis of the case studies of the selected companies have identified a spectrum of business benefits accruing from the deployment of BDAC. These benefits are systematically presented in Table 4 together with the segment where they were identified. As those analysis aimed to capturing the specifics of the companies the benefits identified are often presented in a very specify manner. To facilitate the cross-analysis, Table 16 also classifies these benefits according to the prevailing theme they represent. The resulting categories are as follows:

- Revenue Growth: This category groups benefits such as increased sales, heightened profitability, and elevated conversion rates, all signalling an increase in revenue generation.
- Customer Engagement & Retention: Encompassing increases in NPS, retention, and customer satisfaction, this category reflects the strategic use of data to deepen understanding and connections with customers.
- Cost Management: This includes a variety of cost-related benefits, from broad cost reductions to more targeted operational and sales cost efficiencies, showcasing the cost-disciplined outcomes of BDAC.
- Compliance: Achievements in this category, including the fulfilment of regulators impositions and adherence to regulations like MiFID.
- Supply Chain: Benefits such as the increased use of preferred suppliers and enhanced data sharing practices illustrative of a supply chain increasingly streamlined and collaborative through BDAC.

Table 16: Business Benefits Identified in the Cases

Case	IS/IT Enablers	Segment	Category
Telco	Increased sales	B2B & B2C & Customer Ops	Revenue Growth
	Increased profitability	B2B	Revenue Growth
	NPS increase	B2B & B2C & Customer Ops & FF Ops	Customer Engagement & Retention
	Increased retention	B2B & B2C & Customer Ops & FF Ops	Customer Engagement & Retention
	Cost reduction	B2C & Customer Ops & FF Ops	Cost Management
	Increased fulfillment of mandatory service reposition targets	FF Ops	Compliance
Logistics	Operational costs reduction	Operations	Cost Management
	Improved field force costs management	Operations	Cost Management
	Improved cash-flow	Operations	Cost Management
	Service delivery satisfaction increase	Operations	Customer Engagement & Retention
	Increased assertiveness in regulatory audits responses	Operations	Compliance
	Improved retention rates	Commercial	Customer Engagement & Retention
	Increased sales	Commercial	Revenue Growth
	Improved adoption of new products	Commercial	Revenue Growth
	Faster commercial decision-making	Commercial	Customer Engagement & Retention
Insurance	Efficiency & effectiveness improvements	Auto Ops & Ops Health & Commercial	Cost Management
	Fulfillment of legal response timings	Auto Ops	Compliance
	Increases usage of preferred suppliers	Auto Ops	Supply Chain
	Increases usage of own network	Auto Ops	Cost Management
	Reduced operation costs	Auto Ops	Cost Management
	Increased internal know-how	Auto Ops	Customer Engagement & Retention
	Headcount reduction	Ops Health	Cost Management
	Increased capacity to manage relationship with clients	Ops Health	Customer Engagement & Retention
	Increased clients' satisfaction	Ops Health & Marketing	Customer Engagement & Retention
	Increased capacity to manage relationship with suppliers	Ops Health	Supply Chain

	Improved response times	Ops Health	Customer Engagement & Retention
	Increased sales effectiveness	Commercial	Revenue Growth
	Partners increased commercial capacity	Commercial	Revenue Growth
	Increased retention	Commercial	Customer Engagement & Retention
	Increased sales	Marketing	Revenue Growth
	Reduced campaign costs	Marketing	Cost Management
	Increased campaign conversion rates	Everyday Ops	Revenue Growth
	Reduced staff costs	Everyday Ops	Cost Management
	Reduced campaign costs	Everyday Ops	Cost Management
	Increased NPS	Everyday Ops	Customer Engagement & Retention
	Compliance with MiFID	Investment Ops	Compliance
	Increased client retention	Investment Ops & Commercial	Customer Engagement & Retention
Bank	Clients' funds retention	Investment Ops	Customer Engagement & Retention
	Increased sales	Investment Ops	Revenue Growth
	Reduced sales costs	Investment Ops	Cost Management
	Increased customer satisfaction	Commercial	Customer Engagement & Retention
	Facilitated regulatory compliance	Commercial	Compliance
	Increased sales effectiveness	Commercial	Revenue Growth
	Increased profitability	Commercial	Revenue Growth
	Operational Costs Reduction	Commercial	Cost Management
	IS/IT Enablers	**Segment**	**Category**

Keeping in mind the research's emphasis on operations and marketing activities, it is unsurprising that the most prominent categories of business benefits align with "Customer Engagement & Retention," "Cost Management", and "Revenue Growth". Notably, with respect to customer engagement and retention, there were benefits under this category reported across all studied business activities. This consistency in benefits, transcending sectorial boundaries, is also observed within the cost management category and, to a slightly lesser degree, within the revenue growth category. Such patterns suggest that different activities within the firms are realizing benefits in these categories, irrespective of whether they directly align with their defined organizational roles and missions. This pattern suggests BDAC have a role in driving multifaceted business benefits that may lead to the extension of specific activities objectives beyond their most direct scope.

The category of "Compliance" consolidates distinct benefits observed across all studied companies, thereby reinforcing the argument that BDAC is instrumental in achieving and sustaining compliance-related benefits. Moreover, "Supply Chain" benefits are comparatively less represented, they nonetheless remain significant particularly in the Insurance company. It's important to note that the benefits grouped under this category often exhibit characteristics that could potentially align them with "Cost Management", "Revenue Growth", or even "Customer Engagement & Retention". This overlap reflects the multifaceted nature of BDAC's impact and further cements these latter categories as particularly prominent within the findings of this research. The interrelation between these categories exemplifies the extensive influence of BDAC across diverse aspects of organizational performance, indicating that the benefits of BDAC extend beyond their primary general categorization and contribute to multifaceted benefits.

5.5 Business Objectives

In the analysis of the studied companies, the primary business objectives identified were to improve financial performance, increase customer satisfaction and retention, and ensure regulatory compliance. The most prevailing benefits that contribute to financial performance improvement are those linked with cost management and revenue growth. Cost management benefits are typically associated with reductions in expenditure, predominantly resulting from efficiency gains in processes supported by enhanced decision-making capabilities or process automation initiatives. These efficiencies support the wider goal of financial performance improvement by reducing operational costs.

In the context of revenue growth, the benefits are often possible to trace back to business process changes that have equipped companies with data-driven capabilities that allow them to tailor their offerings more astutely and effectively target customer segments that are most likely to engage. This advantage is rooted in a deeper understanding of customer preferences, which was seen to be instrumental in formulating more successful commercial strategies. This strategic approach is reflected in enhanced sales metrics, indicating a direct positive impact on revenue streams.

Moreover, the benefits related with customer engagement & retention go beyond merely fulfilling objectives of increasing customer satisfaction and retention, which will be explored in greater detail subsequently. They also play a key role in improving financial performance. Operating in highly competitive markets, the studied companies recognize the value of customer loyalty. In such environments, where acquiring new clients can be challenging, the significance of retaining existing customers and enhancing their satisfaction becomes even more pronounced. Therefore, the benefits associated with customer engagement and retention are not just seen as crucial for maintaining a satisfied customer base but are also perceived as vital to ensure financial growth and stability.

The pursuit of increasing customer satisfaction and engagement is predominantly supported by the benefits categorized under customer engagement & retention. These benefits typically derive from changes that enable companies to interact with their

customers in a more personalized manner. The knowledge gathered from BDAC plays a crucial role in transforming how companies engage with their clients, both through digital channels and in physical interactions. The expectation that personalized processes would be found and positively impact customer satisfaction and retention has been validated in the studied companies. Furthermore, it was observed that not only direct customer engagement strategies but also enhancements in process efficiency that are visible to customers, contribute significantly to customer satisfaction. A notable example of this is the observed reduction in wait times for medical expense reimbursements at the insurance company. Such improvements, though operational in nature, directly enhance the customer experience, underscoring the relationship of operational efficiency and customer satisfaction.

This research has also identified the business goal of ensuring regulatory compliance, a significant objective across all the studied companies. While instances of compliance-related benefits were not as frequent as others, their presence was consistently noted in each company. The nature of these compliance-oriented benefits appears twofold. On one hand, some benefits are closely linked to meeting mandatory operational timings, where BDAC has played a pivotal role in enhancing process efficiency. These improvements enable companies to adhere more effectively to time-sensitive regulatory requirements. On the other hand, particularly in the context of the banking sector, the benefits are more intricately associated with the increased capacity for data-driven decision-making. This enhanced capability facilitates the assurance of a more thorough and accurate adherence to regulatory standards. In these instances, BDAC serves as a crucial tool in ensuring that what is offered to clients is compliant with relevant laws and regulations.

5.6 Organizational Decisions and Transformation

Addressing the research questions of this study, specifically: how do firms benefit from big data analytics capabilities? How do firms enable big data analytics capabilities to realize benefits? And, especially, how do firms organize teams within the context of big data analytics capabilities? Necessitates an analysis of how the companies studied are

structured in relation to BDAC, and the organizational dynamics that facilitate the realization of benefits.

Centralization vs Decentralization

The analysis of the four companies revealed distinct approaches to integrating BDAC within their organizational structures, particularly concerning the balance between centralization and decentralization. Although all the companies employ both centralized and decentralized teams, their strategies vary significantly. In terms of team organization, the scope of activities also differs, leading to the identification of two main categories: teams focused on traditional analytics capabilities and teams dedicated to advanced analytics capabilities. Table 17 presents the teams identified by this research.

In analysing the cases with a focus on centralized teams, it was observed that all companies possess centralized teams dedicated to supporting BDAC across the organization. The functional areas of these teams differ, particularly in terms of traditional analytics. When focusing on the initial four steps of data management – data collection, studied activities of the organizations, extraction, and integration (Troisi et al., 2020) – these teams are typically situated within the IS/IT departments. An exception was noted in the Logistics case, where the team responsible for these tasks is located within the planning and control structure, despite previously being part of the IS/IT department. This observation suggests that the initial phases of big data management tend to be centralized, which might theoretically lead to negative impacts of timely responses but could also lead to more rational investment decisions (Away et al., 2021), especially concerning these initial steps. Moreover, it can also be argued that the centralization of these steps could facilitate data governance efforts, still, this research did not collect enough data to address that subject.

Table 17. Centralized and Decentralized Teams Identified

	Telco	Logistics	Bank	Insurance
Centralized Teams	Yes	Yes	Yes	Yes
Centralized Team(s) Area (Focus)	IS/IT (Traditional Analytics)	Planning & Control (Traditional Analytics)	IS/IT & Data (Traditional Analytics & Advanced Analytics)	IS/IT (Traditional Analytics) & Data (Advanced Analytics)
Decentralized Team(s)	Yes	Yes	Yes (hybrid)	Yes
Decentralized Team(s) Area (Focus)	B2B (Traditional Analytics & Advanced Analytics) B2C (Traditional Analytics & Advanced Analytics) Customer Operations (Traditional Analytics) Field Force Operations (Traditional Analytics)	Operations (Traditional Analytics & Advanced Analytics) Commercial (Traditional Analytics)	Everyday Operations (Traditional Analytics)	Marketing (Traditional Analytics & Advanced Analytics) Health Operations (Traditional Analytics) Commercial (Traditional Analytics)

Furthermore, within the centralized teams focusing on traditional analytics, it was observed across all cases that these teams developed traditional analytics solutions benefiting different activities within the companies. Notably, in one case (Bank), the processes of data analysis and sharing (Troisi et al., 2020) were centralized in a team situated outside the IS/IT division. This team was dedicated to BDAC that directly supports business activities and meets business requirements. Therefore, the effects of centralization are also discernible within the context of these steps, indicating its potential impact.

In addition to traditional analytics, centralized teams dedicated to advanced analytics were identified in two of the cases: the Bank and the Insurance companies. These teams

are characterized by their relatively recent formation, with the explicit aim of integrating advanced analytics capabilities into the companies, as it is their main purpose. Notably, both teams were established with a significant degree of financial autonomy, initiated under an exploratory approach with the belief in their potential to deliver additional benefits to the companies. However, the cases diverge in the distribution of advanced analytical skills, in the Bank, the advanced analytics team possesses a monopoly over these skills, a situation not fully mirrored in the Insurance company. The influence of centralization effects on these advanced capabilities are also to be expected as we will further develop.

In analysing the cases with emphasis on decentralized teams, it was observed that all cases included teams categorizable under this classification. Notably, in the Bank case, the identified team exhibited a hybrid composition, adopting an approach referred to by the company as pods. This study managed to identify only one pod, despite references to the existence of others. The team's composition is dualistic, consisting of members who represent – and are part of – the business segment, as well as members from the Data function. Together, they form a virtual team aimed at addressing the specific needs of the segment. Given that some members originate from a centralized function, it could be argued that this team does not fully adhere to a decentralized or centralized model but instead operates as a hybrid. Here, technical decisions are centralized, whereas functional decisions are decentralized.

All identified decentralized teams, apart from the unique hybrid formation, operate with full decentralization. Despite their reliance on some IS/IT enablers provided by the IS/IT function – or, in the case of the Logistics company, the planning and control function – these teams maintain autonomy. This autonomy addresses the anticipated limitations of centralized response timings. Being a dominant theme the belief that by being directly managed by the business activities they support, these teams achieve improved response timings. However, it could be contended that the commitment level of business segment leadership to these teams may influence both this perception, as well as the actual response times. From a governance perspective, concerns were notably

absent, except in the case of the hybrid team. This observation leads to the argument that hybrid teams might balance governance with the strong alignment to business needs characteristic of decentralized teams. Such decentralization facilitates a spread of decision-making related to BDAC, resulting in the advantages of expedited decision-making, enhanced innovation, and heightened responsiveness to customer needs (Away et al. (2021), as is expected of decentralized teams.

Exploring the capabilities of these teams reveals that all possess skills related to traditional analytics, despite the presence of centralized teams also addressing these capabilities. However, advanced analytics are less prevalent among the decentralized teams, with the cases showing greater variation. For instance, in the Logistics company, only one team, that is integrated in operations, was identified to handle advanced analytics. In contrast, the Telecommunications case showed that advanced analytics capabilities were found in multiple distributed teams, although the cases share the fact that there is no central team with these capabilities. Meanwhile, in the Insurance company, advanced analytics capabilities are almost exclusively centralized, except for the marketing team. Similarly, in the Bank, advanced analytics capabilities are solely centralized. The scenarios in the Telco and Logistics cases suggest a tendency towards business activities adopting advanced analytics in the absence of a centralized team providing such services. Conversely, in the Bank and Insurance cases, the existence of centralized teams for advanced analytics appears to meet the companies' needs, with the notable exception of the marketing team in the Insurance company.

It is noteworthy that within decentralized teams, it is possible to find teams that possess both traditional and advanced analytics skills, which contrasts with what is observed in centralized teams where a clear segregation of these capabilities exists. Despite this segregation, the data collected reveals a certain degree of dependency, primarily due to tasks such as data collection, organization, extraction, and integration, which are, to some extent, undertaken by teams specialized in traditional analytics. This suggests that centralized teams often exhibit the mentioned segregation because they are structured around technical skills. In contrast, decentralized teams are primarily

organized based on functional needs, which does not necessarily lead to technical segregation. In decentralized settings, this does not imply an absence of technical differentiation within teams, but rather that a broader spectrum of skills is consolidated under the same team umbrella.

Inducting Advanced Analytics

The research conducted adopts a cross-sectional design. Still, in the context of advanced analytics – capabilities that were relatively recently developed by the studied companies – the data collected facilitates an understanding of how these capabilities were integrated into the companies. From this perspective, the cases split into two distinct patterns. In the Telecommunications and Logistics cases, advanced analytics capabilities were identified exclusively within decentralized teams. Conversely, in the Bank and Insurance cases, new centralized teams were established to capacitate the companies with these more advanced analytical capabilities.

In the first pair of cases, the data collected indicates that the prospect of business benefits, that could derive from these capabilities, led to the recruitment of staff specialized in advanced analytics directly by the business activities. Furthermore, in some teams where these skills were not present at the time of data collection, plans were in place to hire specialists in this field, as observed in the analytics team within the commercial segments of the Logistics case. Additionally, initiatives for skill development in this domain were also identified, as introduced previously in the analysis presented in the individual case studies.

In the second pair of cases, the initiative to integrate advanced analytics into the companies was reported to originate from top management, predicated on the belief that these capabilities could not only confer benefits but also serve as a source of competitive advantage. Consequently, top management in these companies established new teams dedicated to developing these capabilities within the organizations. At the time of data collection for this research, these teams had been operational for approximately six years and had adopted similar strategies, including: (1) recruiting new staff, including those

with higher seniority, with the exception of the executive leader in the Bank's case, although the manager was a new hire; (2) initial investments in the first years that did not necessitate business cases, reflecting an exploratory approach by the teams; (3) collaboration with select business activities that were more open to partnership, facilitating the development of use cases, often under the format of proof of concept, that could later be transformed into success stories for future leverage; and (4) establishment of these teams outside the IS/IT departments, enabling them to adopt more streamlined approaches to demand and delivery management, bypassing the usually more demanding IS/IT processes.

Staffing and People Development

In cross analysing the cases, similarities were observed in how business activities develop their analytical teams (decentralized). Contrary to the composition of teams within support areas such as IS/IT departments, or within specific data analytics and AI departments when these are separate from IS/IT, these business-oriented teams often include employees without prior technical background. This staffing strategy necessitates targeted training efforts, as identified in the cases, aimed at developing staff with a business background with the technical skills essential in the realm of BDAC. Worth noting that the technical skills developed, while varying in the different cases, typically are twofold: (1) specific analytical tools with a relevant footprint in the companies, aimed at taking advantage of the current technological analytical ecosystems; and (2) technologies that fall under the advanced analytics category, which entails an intent to progress to new capabilities.

Moreover, staff with technical backgrounds are recruited and integrated into these decentralized teams, which is argued to foster a balance with the resident business acumen that enhances team effectiveness. Consequently, these decentralized teams exhibit a relevant level of diversity in professional background. Additionally, within the centralized teams identified, more prominent in the Bank case, the advanced analytics team, despite being staffed mostly with individuals with strong technical backgrounds, there was a concerted effort to include people with a variety of backgrounds. This staffing

strategy aiming for diversity was led by the believe that this approach could foster an innovative spirit, which was considered crucial to achieving the objectives set forth for this team.

These patterns support the theory that teams dedicated to BDAC benefit from diverse compositions, as this diversity was seen as having the potential to bolster team effectiveness by ensuring a balance between business acumen and technical skills – a factor unanimously deemed essential by all interviewees. Moreover, this diversity is also associated with efforts to enhance innovative potential by including staff with varied backgrounds, often recruited from outside the organizations. This approach can be viewed as a strategy to incorporate external insights into the companies, which can facilitate the identification of potential changes that could be enabled by BDAC.

Collaboration and Democratization

Multidisciplinary collaboration emerged as the most significant enabler in the cases examined. Therefore, gaining a detailed understanding of how this collaboration functions is crucial within the context of this thesis. Despite the organizational structure of some teams being centralized and others decentralized, the necessity for collaboration to enable BDAC-driven changes emerged as a recurring theme. Centralized teams were often dependent on business activities to grasp business requirements, whereas decentralized teams relied not only on centralized teams – primarily due to certain data management processes being centralized for specific data sources – but also on collaboration with other teams, typically within the same business activity. Although cross-activities collaboration was also identified in some of the cases.

The collaboration among different teams was found to be anchored in analytics, suggesting that data effectively serves as a medium of communication between teams. Consequently, technical proficiency in data analytics is key to enable these collaborative efforts, as is data democratization, which are crucial not only for facilitating the upstream collaboration, but also the downstream benefits. As previously discussed, data democratization is supported by five key enablers (Lefebvre et al., 2021): (1) Broader

data access; (2) Self-service analytics tools; (3) Development of data and analytics skills; (4) Collaboration and knowledge sharing; and (5) Promotion of data value. Which have an overall fit with the findings of this research.

However, our findings do not entirely align with the existing literature on the subject. Data access calls for internal sharing, and even external in some cases. While this was confirmed by this research, the integration of external sources (see top layer of Figure 21) often occurs in the studied cases. Additionally, while the use of self-service analytical tools, and some broader platforms was noted, the application often extended beyond these tools. And while in clear data democratization scenarios (see the side of Figure 21), the advanced technical skills of some of the staff let to an utilization that goes beyond the capabilities of these platforms. Consequently, this research suggests the need to expand the current boundaries of what is considered data democratization. Specifically, it highlights the importance of viewing external sources as a potential integral component of the data pool to ensure its availability, which may have significant implications for governance (though the data collected in this research does allow a thorough analysis of this subject). Moreover, it suggests that the beneficiaries of data democratization may possess more advanced skills than previously assumed. The assumption that the technical profiles of data democratization go beyond what is traditionally expected calls for different data sharing strategies, that can only be designed if this fact is acknowledge by organization.

5.7 Link with Theories

This research is underpinned by a theoretical framework that includes the Resource-Based View (RBV), dynamic capabilities, sociomaterialism, and systems theory. Therefore, it is imperative to assess how the cross-case analysis demonstrates alignment with these theoretical lenses.

Resource-based View

The core assumptions of the RBV, namely that firms possess a unique and heterogeneous mix of resources and that there is some degree of resource immobility, are substantiated in all the cases studied. Central to BDAC is data that is inherently unique to each company. This study has corroborated that uniqueness while identifying these components. However, it is not only data that contributes to this distinctiveness, as the heterogeneous approaches to staffing also create unique blends of backgrounds and skills that enhance the BDAC capabilities.

Moreover, as observed across the cases, the development of these solutions involves collaboration with other teams, further deepening the uniqueness of these capabilities, which are distinguished by the specific business changes undertaken to realize benefits. Thus, leading to overall unique capabilities that embody the specifics of the company that possess them.

The core need for multidisciplinary collaboration to enable BDAC stresses out the concept of resource immobility, as this intricate interplay of personnel and their interactions are not readily transferable between companies. Therefore, this key finding reinforces the pertinence of studying BDAC through the RBV lens. In the individual case analyses, we have demonstrated instances of the VRIO framework to assess the alignment of each case with this theory, as summarized in Table 18. Thus, from an RBV standpoint BDAC can be argued to sustain competitive advantages.

Table 18. VRIO Application to the Cases

Case	Value	Rarity	Imitability	Organization
Telco	Democratized access brings value to the organization by facilitating the exploitation of opportunities place forward by data	The bespoke nature of the data sources and the in-house creation of capabilities lend a degree of exclusivity to the BDAC	The BDAC result of an unique blend of technical skills and specific business acumen	Specific activities are organized in manner that facilitates leveraging BDAC
Logistics	Data related to clients, in both countries, and related with industry-specific logistics	Data related with clients with extensive volume due to the company's history	Company with an unique position with proprietary data is, in part originated from operating in part in monopoly	Recent changes as the organic change of the Data Office. And ongoing model merge with Spain
Insurance	Data originated in a large client base in the market this firm operates, also combined with extensive supplier data	Better time to market in analytics-driven offerings	Benchmarked levels of service achieved with BDAC, supported by high renewals rate	Creation of a specific area to address advanced analytics, and maintenance of a centralized traditional analytical team
Bank	Unique client data, which support several personalization features	Assured by unique internally developed solutions	Closed in-house development and early investment in advanced analytics solutions development and continuous evolution	Advanced analytics team working closely with business segments, and the hybrid model

Dynamic Capabilities

The dynamic capabilities approach, which derives from the RBV, was another fundamental pillar of this research. The companies studied exhibited strategies that align with this theory, as they have integrated, built, and reconfigured competencies, particularly within the context of BDAC. Whether centralized or decentralized, the identified teams illustrate the adaptive capacity of the studied companies. This adaptability is evident in the Bank and Insurance companies, where centralized teams were purposefully established and staffed. In the Telecommunications case, the absence of a centralized unit led to the development of competencies within business units. Similarly, the Logistics company strategically repositioned its data office team to align more closely with business operations, and these are just some examples.

Furthermore, the business changes resulting from BDAC underscore their congruence with the dynamic capabilities framework. Participants frequently described innovative changes, particularly in commercial activities, often concerning client relationship management. Such innovations range from a complete redesign of relationship models driven by BDAC insights, as in the Telco case, to enhanced personalization and refined customer interaction channels, as observed in the Banking case.

Operational activities also exhibited significant dynamic shifts, especially in interactions with suppliers, which were particularly notable in the Telecommunications and Logistics cases. In these cases BDAC also facilitated swift adaptations to comply with evolving regulatory requirements. Therefore, this study's findings support the assertion that BDAC enables competitive advantages by allowing the dynamic reconfiguration of resources. Worth noting that the mentioned reconfigurations were in some case pronouncedly deliberate, e.g., with the constitution on new teams. While in others there reconfigurations emerged organically, e.g., business activities hiring new staff.

Sociomaterialism

The principles of sociomaterialism, which posit that technology and social practices are mutually constitutive, are clearly evident in the findings of this research. This is particularly pronounced when viewing the phenomenon through the lens of benefits management, which recognizes that organizational change is necessary for the realization of benefits. BDAC was not only leveraged by social interactions stemming from multidisciplinary collaboration but was also triggered by such interactions.

Mechanisms of data democratization, found to be foundational to BDAC, are both a result of interactions that necessitate such setups and, conversely, facilitate and amplify interactions that catalyze organizational process changes, with both internal and external ramifications. Internally, transforming work practices, often aiming to enhance efficiency through automation or by refining decision-making processes. Externally, affecting clients through increased service levels or data-driven modifications in company offerings.

With a particular focus on decision-making, BDAC has demonstrated the potential to lead to substantial changes in this regard. Such changes occur due to interactions that either define needs, as distinctly seen in commercial activities across the cases, or support the decision-making process itself, which often call for the proximity of skilled personnel within a BDAC context alongside decision-makers.

Furthermore, contrary to a possible expectation that increased BDAC investment and consequent automation might diminish the need for social interactions, the evidence from these cases suggests that these capabilities motivate a growing requirement for data-supported decision-making. Which call for an intensification of the need for interactions, particularly in conjunction with technology. Therefore, these findings affirm the relevance of sociomaterialism within the context of researches related with this topic.

Systems Theory

BDAC facilitates a comprehensive perspective of companies, especially through its foundation on data aggregated from various sources. The cases studied highlight a predominance of internal sources, endorsing a holistic view of the organization that aligns with systems theory. This research further discovered that teams supporting commercial activities not only utilize sources related to these activities but also incorporate operational data, as distinctly observed in the Telco and Logistics cases. Similarly, operational teams leverage commercial data, a trend consistent across all cases. Thus, from a systems theory perspective, BDAC assumes an integrative role, enhancing the connectivity between different organizational components.

At the exception of the Bank case, the utilization of external data sources, as well as data sharing with external entities, was observed in all other cases studied. Through the lens of systems theory, it can be argued that BDAC enables companies to learn from and adapt to their external environment by establishing connections beyond their immediate boundaries. A notable example was observed in the Telecommunications case, where BDAC is leveraged for benchmarking against other companies, including those outside its sector. This benchmarking is conducted not only from a high-level perspective but also at the activity level, facilitating comparisons with companies across different industries when specific activities are seen as references in the market.

While BDAC aligns well with systems theory in fostering a holistic view, promoting adaptation and learning, and enhancing the system's openness, it also directly engages with feedback loops. Analytics inherently serve the purpose of providing metrics that can lead to improvements in effectiveness and efficiency. Thus, it is unsurprising that the findings of this research echo this aspect of systems theory, further affirming its relevance in examining this phenomenon.

5.8 Discussion

In profit-driven companies, the realization of benefits from IS/IT investments is crucial, and investments related to BDAC are no exception. This research primarily aims to deepen our understanding of how these benefits are realized. While the previous chapter provided individual case analyses to answer that question, this chapter offered a cross-analysis that laid a more robust analytical foundation for discussion. Despite some limitations of the research, which will be discussed in the subsequent chapter, the approach to data collection is believed to have enabled an analysis that extends current knowledge. Notably, the application of benefits management concepts has offered a unique perspective on the phenomenon, yielding insights that encompass the integration of technology, people, and organizational processes.

To fully grasp how companies derive business benefits from BDAC, it is imperative to comprehend the technological underpinnings adopted by these firms. As explored in the section on organizational decisions and transformations, certain processes in big data management – such as data collection, extraction, and integration – are predominantly centralized, with their outputs being served to various teams, whether they be centralized or decentralized. These processes are instantiated through IS/IT components like data lakes and data warehouses. While these components are essential, they mostly serve as the infrastructure facilitating the functions that are more directly aligned with business needs. Furthermore, it is crucial to acknowledge that these infrastructural components underpin data democratization, which has been identified as essential in facilitating the process of realizing business benefits.

Above the foundational infrastructural components, it is critical to distinguish between IS/IT components that leverage big data, which are often segregated into those serving traditional analytics and those dedicated to advanced analytics. Regardless of the technological provider, the use of dashboards prevails in traditional analytics. This prevalence can be attributed to their ease of use and strong visual representation, which facilitates interpretation across individuals regardless of their technical background.

Additionally, in the realm of advanced analytics, this research indicates that the technological enablers not only differ across companies but also within teams of the same organization. A recurring theme is that solutions in this area serve very specific needs and defined use cases. This diversity in technological approaches, coupled with the relatively recent adoption of these technologies, may explain the observed lack of standardization.

In addition to IS/IT enablers, the contribution of components that are not big data technology was identified as critical, given that the majority of data integrated into BDAC ecosystems originates from other systems. These systems, primarily business and operations support systems, supply BDAC with client data, including information crucial for understanding client behaviour. Furthermore, other systems were also recognized as instrumental in leveraging the outcomes of BDAC initiatives, both internally within organizations and externally. This is particularly significant as BDAC was found to be often utilized to augment existing systems with new features, thereby aiming to achieve new business benefits or enhance existing ones.

As anticipated, enabling changes were pivotal for benefit realization. In this context, multidisciplinary collaboration was found to be fundamental to activate BDAC effectively. However, this collaboration is intricate, stemming from varied organizational models that are directly associated with the capabilities under examination. Under BDAC, traditional and advanced analytics approaches diverge. Specifically, the approach to advanced analytics is generally seen to be more targeted and shaped by business activities, suggesting a reaction to fulfil the crucial need for collaboration among staff with diverse profiles. This stresses out the imperative to synergize business acumen with technical skills, in collaborating efforts which is consistently deemed vital for enabling BDAC. Confronting this finding with traditional analytics, where the need for collaboration was also found to be essential, suggests that companies tend to prioritize the introduction of new capabilities even without ensuring cost rationality, at least in earlier stages.

Benefits realization appears to be more readily facilitated within an advanced analytics context, possibly due to a diminished emphasis on cost constraints. However, traditional analytics did not demonstrate a similar disregard for costs, yet benefits were

still achieved, also through multidisciplinary collaboration. Notably, this research identified a consistent presence of staff with technical analytical skills embedded within business activities across all cases, with the exception of the Bank case. This arrangement enables the expedited development of BDAC, reducing dependencies on teams external to business activities. Such a configuration is especially significant when BDAC is expected to support decision-making processes. This supports the hypothesis that positioning BDAC proximate to decision-makers, not as a centralized service but integrated within business activity staff, is of growing importance. Influenced by the necessity for staff possessing analytical skills to be in close proximity, training programs aimed at upskilling staff within business activities have also been identified as crucial for enabling BDAC.

Among the critical enablers identified by this research are the divulgation of BDAC-supported changes and data quality assurance. Regarding the former, promoting awareness of newly implemented capacities emerged as crucial, both internally and externally. Internally, it is vital to ensure that the intended recipients are aware of the BDAC outputs available to them, which might also involve training initiatives. A notable example includes the use of gamification platforms in the telecommunications sector, both in B2C commercial activities and client support operations, where its internal divulgation was deemed essential for adoption and reaching intended benefits. Externally, the dissemination of information was found essential for realizing benefits in certain contexts, as illustrated by enhancements to BDAC-driven digital channels in the Insurance case. Ensuring clients are informed about new features is critical to fostering the adoption of these channels and, consequently, the realization of benefits. Thus, ensuring awareness of the existence of BDAC-based solutions can be argued to be essential to reach benefits realization, especially when the intended recipients were not involved in development stage.

Another critical enabler identified was the necessity to ensure data quality, particularly through one-time initiatives aimed at rectifying data issues. Literature often highlights data quality as crucial for the effectiveness of analytics. Our analysis revealed

that efforts to improve data quality are not confined to the initial stages of data management, which would ensure more efficiency. A notable example is the previously explained strategy implemented in B2C operations in the Telecommunications case, although other examples of downstream data quality efforts were also observed. It is important to note that comprehensive data governance was not consistently identified across all cases, and where it was recognized, there was often a lack of alignment between the participants from commercial and operational activities. Consequently, the necessity for data quality efforts could be attributed to inadequate data governance, despite this research lacks data concerning this aspect.

Process changes are key for understanding how benefits from BDAC are realized. The analysis conducted previously culminated in the delineation of six principal categories of business process changes: decision-making, customer relationship management, human resources management, sales and marketing, operational efficiency, and supply chain management. Unsurprisingly, sales and marketing was found to be exclusively associated with commercial activities, while supply chain management pertained solely to operational activities. The other four categories span across the various activities examined. It is important to emphasize that these process changes were made possible by the enablers identified previously.

Anchoring the discussion of this topic in the literature review, and beginning with decision-making category, changes in this domain were anticipated. Nevertheless, this research offers significant organizational insights, as we observed that alterations in decision-making processes call for the closeness of staff equipped with BDAC skills, who are consequently often integrated within business activities. This arrangement is posited to enhance the effectiveness of BDAC, as it not only can shorten response times but also likely simplifies the capture of business requirements. Therefore, our data indicate that these process changes often lay on proximity between decision-makers and technical staff.

Changes categorized within the customer relationship management category relate to process modifications that clients can directly observe. While the visibility of these

changes to customers may be subtle, and they may not recognize their origin in BDAC. Data suggests that the companies studied are willing to modify externally visible processes to leverage BDAC benefits. Often, these process changes are driven by analytical insights related to behaviour analysis, suggesting an organizational effort to align with anticipated customer behaviour patterns. In some other instances, the goal is mostly to enhance customer experience by simplifying interactions with the company. Regardless of the specific intent, it is important to underscore that changes within this category are associated with both commercial and operational activities, which hints that both these activities believe that changing processes aligned with expected clients' behaviours is a path to realizing benefits.

Few changes categorized under human resources management and supply chain management were identified. However, in both categories, these changes are associated with significant modifications that ultimately led to substantial business benefits. In the context of human resources management, BDAC was instrumental in initiating a transition to a four-day working model. This shift represents a profound organizational change with internal and external impacts. Moreover, changes under the supply chain management category are intimately connected with enhanced information exchange with suppliers. This development holds considerable theoretical interest from a systems theory perspective, as it exemplifies how BDAC can assist companies in functioning as open systems, further supporting what has already been presented.

Changes in business processes, particularly those categorized under sales and marketing, along with operational efficiency, emerged as the most significant findings of this research, proving to be crucial in answering the research questions that guided this study. Sales and marketing process changes, closely linked with commercial activities, were observed across all cases, showing that companies significantly rely on BDAC to shape their offerings and market strategies. This reliance is arguably due to the belief that BDAC-supported insights provide a deeper understanding of market needs and how to effectively address them. Such a shift towards data-driven decision-making in areas traditionally dominated by creative and relational roles suggests a transformative impact

on team dynamics within these domains. Although the cases in this research indicate that training initiatives are addressing this skills gap, this area warrants further investigation to fully understand the implications of integrating BDAC into sales and marketing processes.

At its core, BDAC, as supported by current academic literature, primarily focuses on enhancing effectiveness and efficiency. Therefore, it was anticipated that changes associated with operational efficiency would be prevalent, which indeed was the case. Processes within both commercial and operational activities were modified to integrate increased effectiveness and efficiency, encompassing changes that extend across field force, both physical and digital channels, and quality assurance. These modifications aim for data-informed continuous improvement and can be seen as representing a reinforced rational approach to decision-making, particularly in the pursuit of heightened effectiveness. Additionally, BDAC-powered automation is a significant theme that emerged around this category, although it transcends this category. Consequently, BDAC is posited to aid companies in achieving benefits when their processes are reshaped by these capabilities to become more rational, efficient, and automated. It is important to note, however, that the changes across most categories are highly specific and targeted, indicating that BDAC is utilized in the context of precise and focused efforts, rather than being a universal solution that directly resolves all challenges.

Building upon IS/IT and subsequent enablers, this research has uncovered a spectrum of business benefits. From a high-level perspective, these benefits can broadly be categorized into efficiency and effectiveness gains, aligning with expectations set by current literature on the subject. Delving deeper into these benefits, and particularly within commercial activities, it was observed that all companies experienced revenue growth attributable, at least in part, to BDAC. These benefits often resulted from process changes identified within customer relationship management, and sales and marketing categories as would be expected. Also, customer engagement and retention benefits were primarily seen as outcomes of these process change categories, though operational efficiency was also recognized as playing a relevant role.

Across the board in the studied activities, business benefits were identified within the cost management and compliance categories. These benefits were primarily outcomes of operational efficiency process changes, though changes in sales and marketing processes also contributed to cost management benefits, and alterations in customer relationship management processes facilitated compliance benefits. Such outcomes can be attributed to significant efficiency gains in the respective processes, as well as to an enhancement in the intelligence integrated into those processes. Notably, all benefit categories discussed were observed in all four cases, spanning four distinct industries. This consistency solidifies the argument that BDAC can facilitate the realization of benefits, particularly in these categories, across diverse industry sectors.

The association between benefits categories and primary business objectives is crucial for understanding how business objectives achievement can be supported by the potential benefits that derive from BDAC. Although these connections at the category level might seem apparent, they can serve as a valuable guide for the more detailed analysis that reveals specific insights. Such analysis is especially supportive for practitioners contemplating investments in BDAC-related capabilities. Business objectives aimed at enhancing financial performance are directly supported by benefits categorized as cost management, revenue growth, and customer engagement and retention. Objectives focused on regulatory compliance align with benefits categorized under compliance, while goals related to improving customer satisfaction and retention are met through customer engagement and retention benefits.

Chapter VI – Conclusions

6.1 Key Research Findings

This research has confirmed that BDAC can enable the realization of diverse business benefits. Through the conducted case studies, the most recurrently identified benefits were associated with revenue growth, cost management, customer engagement and retention, and compliance. Notably, companies in this study have leveraged insights into customer behaviour to enhance offer definition and customer engagement strategies. Additionally, operational activities have achieved efficiency improvements, facilitating significant cost reductions by integrating BDAC-supported intelligence into their processes. It was demonstrated that through BDAC the studied companies were found to achieve competitive advantage, both in commercial and operations activities.

The realization of benefits enabled by BDAC was predominantly founded on multidisciplinary collaboration, serving as a conduit for merging technical expertise with business acumen. Or from a different angle, bringing people and technology together. Contrary to the notion that technology-supported decision-making might reduce the need for social interactions, our research suggests the opposite. BDAC frequently acted as a catalyst for congregating various individuals, not only to facilitate decision-making but also to promote innovation.

Data democratization emerged as a crucial element for leveraging business benefits from BDAC. This research identified that the primary activities this research focussed – commercial and operational – were highly reliant on data, underscoring the need for broader access. Democratized access to data proved to be a key mechanism driving organizational changes that lead to business benefits. These changes have both internal and external impacts, internally including transforming work practices to enhance efficiency, often through automation or improved decision-making processes, and externally influencing customers by elevating service levels or introducing data-driven modifications to company offerings.

The necessity for data democratization is arguably enhanced by decentralized organizational structures, which exhibit varying levels. Decentralized teams, as observed across the cases, exhibited a significant demand for data access, underscoring an augmented view of data democratization. This study advocates for recognizing external data sources as essential components of the data pool to ensure availability and acknowledges that data democratization beneficiaries likely possess advanced skills. Such insights call for the development of more explicit data strategies, addressing a notable gap observed in the included cases.

It is relevant to recognize that it was found that centralized and hybrid teams do not emphasize data democratization to the same extent as decentralized teams, often due to their more immediate access to data. For centralized teams in particular, access to business teams is identified as the primary mechanism facilitating collaboration, ensuring engagement with individuals that posses essential business acumen, a factor deemed critical for the success of BDAC-related initiatives. Additionally, the evidence collected indicates that decentralized teams cultivate BDAC capabilities to compensate for the lack of prompt responses from centralized services. This not only underscores the heightened necessity for data democratization but also constitutes a significant finding of this research.

This research delineates a distinction between traditional and advanced analytics within BDAC. Traditional analytics primarily supports data-driven decision-making, whereas advanced analytics focuses on developing solutions for specific business needs, which is clear on the strategy followed to introduce centralized advanced analytics in the Bank and Insurance cases.

Our findings suggest a demand within business activities for technical staff proximity to decision-makers, particularly in the context of traditional analytics. Moreover, while BDAC was found to be overall utilized for targeted and precise efforts, indicating it is not a universal solution for all challenges, this is especially clear in advanced analytics. Furthermore, in both cases, BDAC was instrumental in facilitating firms' operation as open systems. This was achieved by ensuring that decision-making processes incorporate

insights from the external environment and by augmenting information systems with features that establish connections with that environment.

From a technological standpoint, foundational steps in big data management were identified as crucial for facilitating necessary data democratization, which in turn relates to the increasing demand for real-time data, which is often not met. Notably, the use of BDAC to enhance OSS and BSS is significant, particularly relevant when traditional IS/IT processes may not fully meet analytical needs. While decentralized teams often arise to address specific analytical requirements, extending OSS & BSS represents a different challenge. Moreover, decentralized teams may lead to architectural inconsistencies. However, this research suggests that hybrid teams might mitigate such incoherence, while still offering improved responsiveness compared to centralized models.

6.2 Methodological Contributions

The adoption of case study research to explore the realization of BDAC benefits has demonstrated its validity, particularly through the application of a benefits management lens across various companies. This approach provided nuanced insights into how BDAC facilitates business benefits. Additionally, the use of the BDN framework significantly informed the structure of the interview guide, anchored the data collection, and strengthened subsequent analyses.

While this research focussed on BDAC, the methodology – combining case studies with a benefits management perspective and the BDN framework – presents a valuable model for investigating other IS-related research topics. This novel approach not only deepens our understanding of BDAC's impact but also is believed to offer a comprehensive methodological foundation for future research in the field, targeting BDAC-related phenomenon but also other IS topics.

The methodological decision of utilizing Microsoft Teams for data collection is worth mention. This platform facilitated the automatic generation of transcripts, which,

despite necessitating human review to rectify quality issues, significantly reduced manual tasks. This strategic application of technology in qualitative data collection is believed to exemplify a pragmatic and efficient approach, blending modern digital tools with traditional research methods to streamline the analytical process. When combined with the usage of MAXQDA 24, has the potential to facilitate analysis and support the reaching of quality research findings.

6.3 Managerial Contributions

The contributions of this research to practitioners are multifaceted. It highlights organizational models, particularly regarding decentralization, to aid in making decisions that align with specific operational contexts. Additionally, the strategies identified for personnel staffing and development offer guidance for restructuring efforts aimed at enhancing or integrating BDAC capabilities. Notably, the research underscores the importance of upskilling within decentralized teams and the pursuit of diverse profiles in centralized teams, providing a practical insights for leveraging BDAC effectively across different organizational structures.

During this research, a notable trend emerged: a significant increase in investments or intentions to invest in advanced analytics. The strategies followed in the cases studied had clear approaches and were similar and potentially replicable in other organizations. Specifically, these strategies involved staffing centralized teams with diverse backgrounds from the outset, focusing on identifying business use cases for quick implementation as proof of concept to build credibility and encourage future collaboration across different business units. This approach underlines the belief that a diverse team composition enhances the ideation process, which can further leverage the benefits achieved.

Data quality emerged as a universal challenge among the teams in this study. Centralized teams, typically responsible for initial data management steps, often believe in their efficacy in ensuring data quality, revealing a notable discrepancy. This situation

underscores the need for data quality strategies that leverage the common model of partial centralization. Despite some cases suggesting data governance addresses this issue, feedback from commercial and operational sectors indicates a gap. Therefore, it's crucial for any company aiming to enhance their BDAC to pay special attention to data quality strategies.

6.4 Limitations and Future Research

This research encountered some limitations worth mentioning. Collaboration with the four participating companies was crucial, yet it presented challenges. Many interviewees viewed their BDAC specifics as competitive advantages and were hesitant to share detailed information with the researchers. While the coverage of commercial, operational, and IS/IT activities allowed for consistent focus, the level of detail in the information shared varied. Business benefits shared information was often limited, which led to the adoption of a high-level view. Additionally, the extent of IS/IT information varied significantly among the cases, leading to some lack on balanced in the data collected. Furthermore, with more data regarding business benefits, the challenge of measuring the actual value created by BDAC could be addressed.

This research aimed to cover data governance, yet constraints in collaboration limited its scope. The intersection of data governance and decentralization represents a significant avenue for future research, particularly due to the growing prevalence of decentralized teams in BDAC contexts. Moreover, the movement towards decentralization necessitates further investigation into how these teams can be more effectively enabled. This study's identification of new frontiers in data democratization underscores the need for innovative strategies, offering rich potential for future research.

This research focused primarily on commercial and operational activities, it would be relevant applying a similar methodology to other primary and support activities. Additionally, exploring these dynamics in companies across industries beyond the ones included in this research may further enrich our understanding on this phenomenon.

Furthermore, examining how marketing and commercial teams adapt to the proliferation of BDAC throughout time – given their traditionally creative and relational roles – merits special attention. Lastly, the observed trend of decision-makers surrounding themselves with technically skilled staff in the BDAC context presents an intriguing area for further investigation, highlighting the evolving nature of decision-making processes in the data-driven digital age.

References

Abbasi, A., Sarker, S., & Chiang, R. H. (2016). Big data research in information systems: Toward an inclusive research agenda. *Journal of the Association for Information Systems*, *17*(2), I–XXXII.

Acemoglu, D., Aghion, P., Lelarge, C., Van Reenen, J., & Zilibotti, F. (2007). Technology, information, and the decentralization of the firm. *The Quarterly Journal of Economics*, *122*(4), 1759–1799.

Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R., & Childe, S. J. (2016). How to improve firm performance using big data analytics capability and business strategy alignment? *International Journal of Production Economics*, *182*, 113–131.

Alyahya, M., Aliedan, M., Agag, G., & Abdelmoety, Z. H. (2023). Understanding the relationship between big data analytics capabilities and sustainable performance: The role of strategic agility and firm creativity. *Sustainability*, *15*(9), 7623.

Amit, R., & Schoemaker, P. J. H. (1993). Strategic assets and organizational rent. *Strategic Management Journal*, *14*(1), 33–46.

Away, F. A., Simamora, B., Nadeak, S. I., Nugraha, M. S., Prasetia, I., & Hendriarto, P. (2021). Decentralization, centralization and quality of organizational performance of human resources. *Academy of Strategic Management Journal*, *20*(3), 1–12.

Awasthi, P., & George, J. J. (2020). A case for data democratization. In *Proceedings of the 26th Americas Conference on Information Systems (AMCIS)*, Virtual conference, *23*, August 10.

Baesens, B., Bapna, R., Marsden, J. R., Vanthienen, J., & Zhao, J. L. (2016). Transformational issues of big data and analytics in networked business. *MIS Quarterly*, *40*(4), 807–818.

Balachandran, B. M., & Prasad, S. (2017). Challenges and benefits of deploying big data analytics in the cloud for business intelligence. *Procedia Computer Science*, *112*, 1112–1122.

Barney, J. B., & Hesterly, W. S. (2010). *Strategic management and competitive advantage: Concepts*. Prentice Hall.

Barton, D., & Court, D. (2012). Making advanced analytics work for you. *Harvard Business Review*, *90*(10), 78–83.

Baskerville, R. L., Davison, R. M., Kaul, M., Malaurent, J., & Wong, L. H. (2022). Information systems as a nexus of information technology systems: A new view of information systems practice. *Journal of Information Technology*, *37*(4), 387–406.

Bedeley, R. T., Ghoshal, T., Iyer, L. S., & Bhadury, J. (2018). Business analytics and organizational value chains: A relational mapping. *Journal of Computer Information Systems*, *58*(2), 151–161.

Bellin, E., Fletcher, D. D., Geberer, N., Islam, S., & Srivastava, N. (2010). Democratizing information creation from health care data for quality improvement, research, and education-the Montefiore Medical Center experience. *Academic Medicine*, *85*(8), 1362–1368.

Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly*, 11(3), 369–386.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. V. (2013). Digital business strategy: Toward a next generation of insights. *MIS Quarterly*, 37(2), 471–482.

Bowman, C., & Ambrosini, V. (2003). How the resource-based and the dynamic capability views of the firm inform corporate-level strategy. *British Journal of Management*, *14*(4), 289–303.

Boyd, D., & Crawford, K. (2012). Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon. *Information, Communication and Society*, *15*(5), 662–679.

Cao, G., & Duan, Y. (2014). A path model linking business analytics, data-driven culture, and competitive advantage. European Conference *on* Information Systems (ECIS).

Chaudhuri, S., Dayal, U., & Narasayya, V. (2011). An overview of business intelligence technology. *Communications of the ACM*, *54*(8), 88–98.

Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly*, 36(4), 1165–1188.

Cohen, M. A. (2015). Inventory management in the age of big data. *Harvard Business Review*, *94*, 1–5.

Constantiou, I. D., & Kallinikos, J. (2015). New games, new rules: Big data and the changing context of strategy. *Journal of Information Technology*, *30*(1), 44–57.

Contractor, F., Yang, Y., & Gaur, A. S. (2016). Firm-specific intangible assets and subsidiary profitability: The moderating role of distance, ownership strategy and subsidiary experience. *Journal of World Business*, *51*(6), 950–964.

Côrte-Real, N., Oliveira, T., & Ruivo, P. (2017). Assessing business value of Big Data Analytics in European firms. *Journal of Business Research*, *70*, 379–390.

Davenport, T. H. (2006). Competing on analytics. *Harvard Business Review*, *84*(1), 98.

Davenport, T. H., & Harris, J. G. (2007). *Competing on analytics: The new science of winning Boston*. Harvard Business School Publishing.

Davenport, T. H., Barth, P., & Bean, R. (2012). How "big data" is different. *MIT Sloan Management Review*, *54*, 43–46.

Davis, C. K. (2014). Beyond data and analysis. *Communications of the ACM*, *57*(6), 39–41.

Demchenko, Y., Grosso, P., De Laat, C., & Membrey, P. (2013). Addressing big data issues in scientific data infrastructure. In International conference on collaboration technologies and systems (CTS), *2013* (pp. 48–55). IEEE Publications.

Dinh, L. T. N., Karmakar, G., & Kamruzzaman, J. (2020). A survey on context awareness in big data analytics for business applications. *Knowledge and Information Systems*, *62*(9), 3387–3415.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*(10–11), 1105–1121.

El-Kassar, A. N., & Singh, S. K. (2019). Green innovation and organizational performance: The influence of big data and the moderating role of management commitment and HR practices. *Technological Forecasting and Social Change*, *144*, 483–498.

Elgendy, N., & Elragal, A. (2014). Big data analytics: A literature review paper. In *Advances in data mining. Applications and theoretical aspects*. *Proceedings of the 14*: 14th Industrial Conference, ICDM 2014, St. Petersburg, Russia, July 16–20, 2014 (pp. 214–227). Springer International Publishing.

Fan, X., Chen, C., & Yuan, L. (2022). Centralization and firm performance: New evidence on the role of firm size. *Wireless Communications and Mobile Computing*, *2022*, 1–17.

Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management*, *35*(2), 137–144.

Garmaki, M., Boughzala, I., & Wamba, S. F. (2016). The effect of big data analytics capability on firm performance. In *Proceedings of the 20th Pacific Asia Conference on Information Systems (PACIS)*.

George, G., Haas, M. R., & Pentland, A. (2014). Big data and management. *Academy of Management Journal*, *57*(2), 321–326.

George, G., Osinga, E. C., Lavie, D., & Scott, B. A. (2016). Big data and data science methods for management research. *Academy of Management Journal*, *59*(5), 1493–1507.

Ghasemaghaei, M., Hassanein, K., & Turel, O. (2015). Impacts of big data analytics on organizations: A resource fit perspective. In *Proceedings of the 21st Americas Conference on Information Systems (AMCIS)*.

Gobble, M. M. (2013). Big data: The next big thing in innovation. *Research-Technology Management*, *56*(1), 64–67.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of qualitative research*, *2*, *105*, (163–194).

Günther, W. A., Rezazade Mehrizi, M. H. R., Huysman, M., & Feldberg, F. (2017). Debating big data: A literature review on realizing value from big data. *The Journal of Strategic Information Systems*, *26*(3), 191–209.

Gupta, M., & George, J. F. (2016). Toward the development of a big data analytics capability. *Information and Management*, *53*(8), 1049–1064.

Hagel, J. (2015). Bringing analytics to life. *Journal of Accountancy*, *219*(2), 24.

Hagstrom, M. (2012). High-performance analytics fuels innovation and inclusive growth: Use big data, hyperconnectivity and speed to intelligence to get true value in the digital economy. *Journal of Advanced Analytics*, *2*, 3–4.

Herriott, R. E., & Firestone, W. A. (1983). Multisite qualitative policy research: Optimizing description and generalizability. *Educational Researcher*, *12*(2), 14–19.

Hirschheim, R. (1985). Information systems epistemology: An historical perspective. *Research Methods in Information Systems*, *9*, 13–35.

Hyun, Y., Kamioka, T., & Hosoya, R. (2020). Improving agility using big data analytics: The role of democratization culture. *Pacific Asia Journal of the Association for Information Systems*, *12*(2), 34–62.

Jensen, M. H., Nielsen, P. A., & Persson, J. S. (2023). From big data technologies to big data benefits. *Computer*, *56*(6), 52–61.

Jensen, M. H., Persson, J. S., & Nielsen, P. A. (2023). Measuring benefits from big data analytics projects: An action research study. *Information Systems and e-Business Management*, *21*(2), 323–352.

Kauffman, R. J., Srivastava, J., & Vayghan, J. (2012). Business and data analytics: New innovations for the management of e-commerce. *Electronic Commerce Research and Applications*, *11*(2), 85–88.

Kavitha, D., & Chinnasamy, A. (2021). Ai integration in data driven decision making for resource management in Internet of things (Iot): A survey. In *10th International Conference on Internet of Everything, Microwave Engineering, Communication and Networks (IEMECON)*, *2021* (pp. 1–5). IEEE Publications.

Keshavarz, H., Mahdzir, A. M., Talebian, H., Jalaliyoon, N., & Ohshima, N. (2021). The value of big data analytics pillars in telecommunication industry. *Sustainability*, *13*(13), 7160.

Kiron, D., Prentice, P. K., & Ferguson, R. B. (2014). The analytics mandate. *MIT Sloan Management Review*, *55*(4), 1.

Kung, L., Kung, H. J., Jones-Farmer, A., & Wang, Y. (2015). Managing big data for firm performance: A configurational approach. In *Americas conference on information systems (AMCIS)*.

Kwon, O., Lee, N., & Shin, B. (2014). Data quality management, data usage experience and acquisition intention of big data analytics. *International Journal of Information Management*, *34*(3), 387–394.

Labadie, C., Legner, C., Eurich, M., & Fadler, M. (2020). FAIR enough? Enhancing the usage of enterprise data with data catalogs. In *Proceedings of the 22nd IEEE Conference on Business Informatics (CBI)*, 1, Antwerp, Belgium, June 22 (pp. 201–210).

Lamba, H. S., & Dubey, S. K. (2015). Analysis of requirements for big data adoption to maximize IT business value. In *4th International Conference on Reliability, Infocom Technologies and Optimization (ICRITO)(Trends and Future Directions)*, 2015 (pp. 1–6). IEEE Publications.

Lau, R. Y. K., Zhao, J. L., Chen, G., & Guo, X. (2016). Big data commerce. *Information and Management*, *53*(8), 929–933.

Laudon, K., & Laudon, J. (2015). *Managing information systems: Managing the digital firm* (14th ed.). Pearson.

LaValle, S., Lesser, E., Shockley, R., Hopkins, M. S., & Kruschwitz, N. (2011). Big data, analytics and the path from insights to value. *MIT Sloan Management Review*, *52*(2), 21–32.

Lee, A. S., & Baskerville, R. L. (2003). Generalizing generalizability in information systems research. *Information Systems Research*, *14*(3), 221–243.

Lefebvre, H., Legner, C., & Fadler, M. (2021). Data democratization: Toward a deeper understanding. In *Proceedings of the International Conference on Information Systems (ICIS)*.

Leonardi, P. M. (2011). When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies. *MIS Quarterly*, *35*(1), 147–167. https://www.jstor.org/stable/23043493.

Leonardi, P. M. (2012). Materiality, sociomateriality, and socio-technical systems: What do these terms mean? How are they different? Do we need them? In P. M. Leonardi, B. A. Nardi, & J. Kallinikos (Eds.), *Materiality and organizing: Social interaction in a technological world* (pp. 25–48). Oxford University Press.

Liu, Y. (2014). Big data and predictive business analytics. *The Journal of Business Forecasting*, *33*(4), 40.

Loebbecke, C., & Picot, A. (2015). Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda. *The Journal of Strategic Information Systems*, *24*(3), 149–157.

Makadok, R. (1999). Interfirm differences in scale economies and the evolution of market shares. *Strategic Management Journal*, *20*(10), 935–952.

McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D. J., & Barton, D. (2012). Big data: The management revolution. *Harvard Business Review*, *90*(10), 60–68.

Mikalef, P., Pappas, I. O., Krogstie, J., & Giannakos, M. (2018). Big data analytics capabilities: A systematic literature review and research agenda. *Information Systems and e-Business Management*, *16*(3), 547–578.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook*. 3rd. SAGE.

Müller, O., Fay, M., & Vom Brocke, J. (2018). The effect of big data and analytics on firm performance: An econometric analysis considering industry characteristics. *Journal of Management Information Systems*, *35*(2), 488–509.

Müller, O., Junglas, I., Brocke, J. V., & Debortoli, S. (2016). Utilizing big data analytics for information systems research: Challenges, promises and guidelines. *European Journal of Information Systems*, *25*(4), 289–302.

Oliveira, M., Bitencourt, C., Teixeira, E., & Santos, A. C. (2013). Thematic content analysis: Is there a difference between the support provided by the MAXQDA® and NVivo® software packages. In *Proceedings of the 12th European Conference on Research Methods for Business and Management Studies*, (304–314).

Olsson, A., Wadell, C., Odenrick, P., & Bergendahl, M. N. (2010). An action learning method for increased innovation capability in organisations. *Action Learning: Research and Practice*, *7*(2), 167–179.

Olszak, C. M. (2014). Towards an understanding Business Intelligence. A dynamic capability-based framework for Business Intelligence. In. *Annals of Computer Science and Information Systems* Federated conference on computer science and information systems. IEEE Publications, *2014*, (1103–1110).

Opresnik, D., & Taisch, M. (2015). The value of big data in servitization. *International Journal of Production Economics*, *165*, 174–184.

Orlikowski, W. J. (2007). Sociomaterial practices: Exploring technology at work. *Organization Studies*, *28*(9), 1435–1448.

Orlikowski, W. J., & Baroudi, J. J. (1991). Studying information technology in organizations: Research approaches and assumptions. *Information Systems Research*, *2*(1), 1–28.

Orlikowski, W. J., & Scott, S. V. (2008). 10 Sociomateriality: Challenging the separation of technology, work and organization. *The Academy of Management Annals*, *2*(1), 433–474.

Oesterreich, T. D., Anton, E., Teuteberg, F., & Dwivedi, Y. K. (2022). The role of the social and technical factors in creating business value from big data analytics: A meta-analysis. *Journal of Business Research*, *153*, 128–149.

Patton, M. Q. (2015). *Qualitative research and evaluation methods* (4th ed.). SAGE.

Pastorino, R., De Vito, C., Migliara, G., Glocker, K., Binenbaum, I., Ricciardi, W., & Boccia, S. (2019). Benefits and challenges of Big Data in healthcare: An overview of the European initiatives. *European Journal of Public Health*, *29* Suppl. 3(Supplement_3), 23–27.

Pareek, A., & Gupta, M. (2012). Review of data mining techniques in cloud computing database. *International Journal of Advanced Computer Research*, *2*(2), 52.

Peppard, J., Ward, J., & Daniel, E. (2007). Managing the realization of business benefits from IT investments. *MIS Quarterly Executive*, *6*(1).

Peteraf, M. A., & Barney, J. B. (2003). Unraveling the resource-based tangle. *Managerial and Decision Economics*, *24*(4), 309–323.

Pettigrew, A., & Whipp, R. (1991). *Managing change for corporate success*. Blackwell Publishing.

Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. The Free Press.

Porter, M. E. (2001). Strategy and the Internet. *Harvard Business Review*, March, 62–78.

Porter, M. E., & Millar, V. E. (1985). How information gives you competitive advantage. *Harvard Business Review*., 63(4), 149-160.

Ranjan, J., & Foropon, C. (2021). Big data analytics in building the competitive intelligence of organizations. *International Journal of Information Management*, *56*, 102231.

Rasch, A., & Wambach, A. (2009). Internal decision-making rules and collusion. *Journal of Economic Behavior and Organization*, *72*(2), 703–715.

Rose, J., Berndtsson, M., Mathiason, G., & Larsson, P. (2017). The advanced analytics Jumpstart: definition, process model, best practices. *JISTEM-Journal of Information Systems and Technology Management*, 14, 339-360.

Russom, P. (2011). Big data analytics. *TDWI best practices report, fourth quarter*, 19(4), 1–34.

Samarasinghe, S., & Lokuge, S. (2022). *Exploring the critical success factors for data democratization. arXiv preprint arXiv:2212.03059*.

Sagiroglu, S., & Sinanc, D. (2013). Big data: A review. In. *2013 International Conference on Collaboration Technologies and Systems (CTS)* (pp. 42–47). IEEE Publications.

Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). Pearson.

Schroeck, M., Shockley, R., Smart, J., Romero-Morales, D., & Tufano, P. (2012). Analytics: The real-world use of big data. *IBM Global Business Services*, *12*, 1–20.

Seddon, J. J. J. M., & Currie, W. L. (2017). A model for unpacking big data analytics in high-frequency trading. *Journal of Business Research*, *70*, 300–307.

Shahid, N. U., & Sheikh, N. J. (2021). Impact of big data on innovation, competitive advantage, productivity, and decision making: Literature review. *Open Journal of Business and Management*, *09*(2), 586–617.

Shuradze, G., & Wagner, H. T. (2016). Towards a conceptualization of data analytics capabilities. In 49th Hawaii International Conference on System Sciences (HICSS), *2016* (pp. 5052–5064). IEEE Publications.

Strawn, G. O. (2012). Scientific research: How many paradigms? *Educause Review*, *47*(3), 26.

Sun, E. W., Chen, Y. T., & Yu, M. T. (2015). Generalized optimal wavelet decomposing algorithm for big financial data. *International Journal of Production Economics*, *165*, 194–214.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533.

Treuhaft, S. (2006). The democratization of data: How the Internet is shaping the work of data intermediaries. UC Berkeley: *Institute of Urban and Regional Development*. Retrieved from https://escholarship.org/uc/item/32961226

Trieu, V. H. (2017). Getting value from Business Intelligence systems: A review and research agenda. *Decision Support Systems*, *93*, 111–124.

Troisi, O., Maione, G., Grimaldi, M., & Loia, F. (2020). Growth hacking: Insights on data-driven decision-making from three firms. *Industrial Marketing Management*, *90*, 538–557.

Verma, S., Bhattacharyya, S. S., & Kumar, S. (2018). An extension of the technology acceptance model in the big data analytics system implementation environment. *Information Processing and Management*, *54*(5), 791–806.

Wamba, S. F., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015). How "big data"can make big impact: Findings from a systematic review and a longitudinal case study. *International Journal of Production Economics*, *165*, 234–246.

Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J. F., Dubey, R., & Childe, S. J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. *Journal of Business Research*, *70*, 356–365.

Wang, L., & Alexander, C. A. (2015). Big data driven supply chain management and business administration. *American Journal of Economics and Business Administration*, *7*(2), 60–67.

Wang, Y., Kung, L., & Byrd, T. A. (2018). Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. *Technological Forecasting and Social Change*, *126*, 3–13.

Ward, J., & Daniel, E. (2012). *Benefits management: How to increase the business value of your IT projects*. John Wiley & Sons.

Ward, J., Taylor, P., & Bond, P. (1996). Evaluation and realisation of IS/IT benefits: An empirical study of current practice. *European Journal of Information Systems*, *4*(4), 214–225.

Watson, H. J., & Wixom, B. H. (2007). The current state of business intelligence. *Computer*, *40*(9), 96–99.

White, C. (2011). *Using big data for smarter decision making IBM*. Yorktown Heights, NY.

Wynn, Jr., D., & Williams, C. (2008). Critical realism-based explanatory case study research in information systems. In *Proceedings of the 29nd International Conference on Information Systems, Paris, France*, December 14–17.

Wynn, Jr., D., & Williams, C. K. (2012). Principles for conducting critical realist case study research in information systems. *MIS Quarterly*, 36(3), 787–810.

Wixom, B. H., Yen, B., & Relich, M. (2013). Maximizing value from business analytics. *MIS Quarterly Executive*, *12*(2).

Xu, P., & Kim, J. (2014). Achieving dynamic capabilities with business intelligence. In *PACIS*, (330).

Yates, K., Sapountzis, S., Lou, E., & Kagioglou, M. (2009). BeReal: Tools and methods for implementing benefits realisation and management. In *5th Nordic Conference on Construction Economics and Organisation*. Reykjavík (pp. 223–232).

Yin, R. (2018). *Case Study Research and Applications – Design & Methods* (6th ed.). SAGE.

Yiu, C. (2012). *The big data opportunity*, 1 p. 36. Policy Exchange.

Appendix A – Interviews Detail

Case	Interviewee Position	Interview Date	Duration
Telco	Director of Business to Consumer Segment	March 27th 2023	0:35
Telco	Analytics Manager of Business to Business Segment	April 14th 2023	0:52
Telco	Field Force Analytics and Support Manager	May 16th 2023	0:44
Telco	Support Office Manager of Customer Operations	May 29th 2023	0:33
Telco	Business Intelligence Manager of IS/IT	June 14th 2023	0:30
Logistics	Executive Director (Planning & Control)	May 12th 2023	0:41
Logistics	Data Office Manager	May 29th 2023	0:32
Logistics	Executive Director (Commercial Segments)	May 30th 2023	0:41
Logistics	Executive Director (Operations)	June 30th 2023	0:43
Insurance	Automobile Operations Manager	June 12th 2023	1:00
Insurance	BI Manager of Marketing	June 23rd 2023	0:42
Insurance	IS/IT Director	June 28th 2023	0:36
Insurance	Director of Advanced Analytics	July 14th 2023	1:00
Insurance	Health Operations Manager	September 1st 2023	0:39
Insurance	Commercial Director (South)	September 12th 2023	0:45
Bank	CRM Director	May 12th 2023	0:47

Bank	Investments Director	June 5th 2023	0:37
Bank	Analytics Director	June 15th 2023	0:44
Bank	Everyday Director	June 20th 2023	0:39
Bank	Commercial Director	July 18th 2023	0:39

Appendix B – Interview Guide

Introduction

(researcher)

Research contextualization and researcher background

Anonymity clarification

(interviewee)

What is the professional background and education?

Job role and responsibility scope?

Primary activities (Commercial or Operations) + IS/IT and/or Data

Big data analytics access & usage

Access to analytics originated in big data?

Data accessed description, origin, and support solutions? *(key metrics and KPI's to measure success?)*

Analytics usage? *(business problems/opportunities, Data-driven decision-making)*

Data governance awareness?

Big data analytics production

Does individual and/or team under responsibility produce analytics based on big data? How?

Analytics shared with other departments? How?

Challenges and obstacles that impact activities?

Future investment plans?

Business benefits from BDAC

Specific department/activities benefits?

Overall benefits?

Link with business objectives? Drivers?

Competitive advantages supported by BDAC?

Organization related with BDAC?

Only IS/IT and/or Data

Data strategy & governance

- Data strategy(ies) in place in the company?
- Link with business strategy?
- Data democratization objectives?
- How data governance is assured? And data quality?
- Key metrics and/or KPI's?

Data Architecture

- Technology used?
- Current architecture, past decisions description, and future plans?
- Scalability and sustainability assurance?